MARCH

THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION AND THE DENTAL COSMOS

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TRAUMATIC AND FUNCTIONAL INJURIES OCCURRING IN THE SUPPORTING TISSUES OF HUMAN TEETH*

By EDGAR D. COOLIDGE, M.S., D.D.S., Chicago, Ill.

THE clinical aspect of traumatic occlusion has been extensively discussed in modern dental literature. On the other hand, the study of the pathologic changes produced by excessive occlusal stress has received but little attention. Since many traumatic injuries to the bone and periodontal tissues can be observed during the study of sections through human teeth and jaws, this report has been prepared in the hope of contributing toward a better knowledge of the morphologic aspect of excessive occlusal stress.

REVIEW OF THE LITERATURE

The first studies made from the biologic approach were pursued with a desire to obtain a better understanding of the effects of the movement of teeth in the practice of orthodontia.

Sandstedt[1] and Oppenheim[2] reported studies of experiments on animals, the purpose of which was to determine the nature of the bone changes occurring in orthodontic tooth movement. When a gentle, steady pressure was applied to a tooth, the alveolar bone was rapidly resorbed from the path of the moving tooth, and in the direction of the pressure, and rapidly built in in its wake on the alveolar wall from which the tooth was receding. By this continuous resorption and rebuilding of bone, the effort of Nature was to maintain a uniform functional width of the periodontal space during tooth movement. Both Sandstedt and Oppenheim recognized a principle that bone resorption and rebuilding occur on each side of a moving tooth, but in a different order. By this process, the alveolar bone plates are maintained at a fairly uniform thickness. As the bone on the side of pressure is removed, its outer surface is constantly reinforced with new bone, and thus functional support for the tooth is maintained. On the side of tension, the tooth gradually moves away from the bone and new

*From the Foundation for Dental Research of the Chicago College of Dental Surgery.

bone spicules are laid down to fill in the space. To prevent excessive thickness of the alveolar bone, simultaneous resorption gradually reduces the outer wall of the alveolus. When tooth movement ceases, a normal arrangement of bone and periodontal space is created and periodontal fibers are restored between root surface and alveolar wall within a very short time.

Johnson, Appleton and Rittershofer,[3] in an experiment upon young monkeys, observed that in the tipping movement of a tooth, the fulcrum point was located somewhere between the apex and the middle of the root. This finding differed from the findings reported by Oppenheim, who described the tooth as a single arm lever with the apex as the axis or fulcrum. Schwarz[4] and Gottlieb and Orban[5] substantiated the findings of Johnson, Appleton and Rittershofer. In these experiments, the resorption of alveolar bone occurring in the apical region was found on the opposite side from which the crown of the tooth was moving and proved that the apex moves in the direction opposite to that in which the crown moves. This occurrence of a pressure area at the apex on the opposite side from the pressure area at the cervical portion of the root was accounted for by Oppenheim by the fact that he used only a gentle moving force; whereas, in the other experiments, stronger forces were applied.

Schwarz[4] experimented on the teeth of dogs, using a measured moving force. He was able to determine the amount of force required to crush the periodontal membrane between the root and alveolar wall. A force of 20 gm. per square centimeter of root surface caused uniform bone resorption on the side of pressure, and bone building on the side of tension, without any evidence of injury in the periodontal tissues. When a force of 60 gm. per square centimeter was applied, the periodontal tissue was crushed and bone resorption delayed. This delay was due to the fact that the resorbing cells could not function because the tissue containing them had been damaged or destroyed. Schwarz arrived at the conclusion that the periodontal tissues would sustain, without traumatic injury, a pressure equal to but not exceeding the capillary blood pressure of about 20 gm. per square centimeter of root surface under stress. When stronger forces were used, *i.e.*, forces exceeding capillary blood pressure, he found areas where the periodontal soft tissue had been pinched and was necrotic. Resorbing cells in these areas were destroyed and the bone beneath the necrotic tissue was removed by an undermining process, as described by Orban.[6] Tooth movement was delayed when excessive force was applied, because the root surface, being in contact with the bone itself, had destroyed the soft structures containing the resorbing cells, and undermining resorption from adjacent living tissue had to remove the bone and necrotic tissue from the path of the moving tooth.

Fig. 1.—Jaw 17: Right and left sides of jaws of a boy, 11 years old, who died of scarlet fever. Histologic study of the periodontal tissues in this case reveals many areas of damage from occlusal stress. Photomicrographs of some of these areas are shown in Figures 2 to 7.

Stuteville[7] studied the influence of various applications of known orthodontic forces on human teeth. From histologic preparations, Stuteville concludes that orthodontic tooth movement is impossible without at least some injury to tooth and periodontal tissues. Shallow root resorption was found in practically all teeth and necrotic areas were found in the periodontal membrane in a large percentage of cases. These traumatic injuries are repaired as soon as the intensity of the orthodontic force is lessened, and they do not result in any permanent damage to the teeth or tissues.

Marshall,[8] by the use of strong force in an experiment in tooth movement on rhesus monkeys, caused fractures of the alveolar process and extensive resorption of the cementum and dentin. Such gross injuries differ from injuries caused by usual orthodontic treatment or those caused by excessive occlusal stress in human jaws, but the experiment emphasizes the fact that any tissue has a limited tensile strength.

The purpose of the experiments of Sandstedt, Oppenheim, Johnson, Appleton and Rittershofer, Schwarz, Marshall and Stuteville was to observe the tissue reaction to orthodontic force used in the movement of teeth. Where strong force was used, injuries occurred in the periodontal tissue. Extensive bone resorption and occasional root resorption were observed. The report of these findings, mostly from experiments on animals, was followed by intensive study of human material, which revealed injuries similar to those caused by experiments on animals. Such studies were made by Bauer, Gottlieb, Orban, Weinmann, Kronfeld, Euler, Adrion and Grohs.

Bauer[9] reported hemorrhage in the periodontal tissue of a deciduous molar and also cementum fractures on bicuspid teeth in the jaw of an adult. Gottlieb[10] discussed the biologic aspect of traumatic occlusion and explained tissue changes in the periodontal membrane and alveolar bone under the influence of sudden strong force on teeth in an abnormal position or teeth which had lost some of their functional capacity.

Gottlieb and Orban,[5] in experiments on dogs, raised the bite by means of metal crowns cemented on the teeth and also changed the direction of force by sloping the occlusal surfaces to an extreme oblique plane. They found that, under heavy pressure, the periodontal tissue in the area of pressure became thinner or

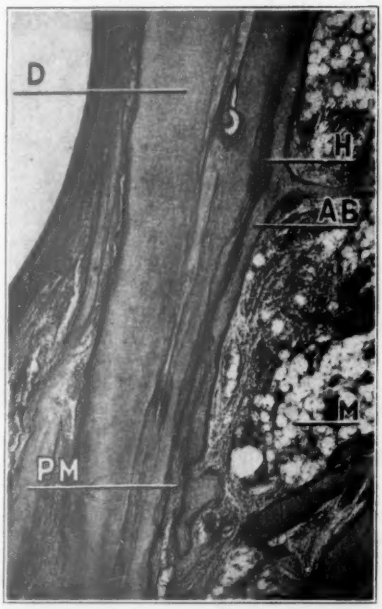

Fig. 2.—Jaw 17: Mesial root of lower left second deciduous molar. D, dentin. PM, periodontal membrane. AB, alveolar bone. H, hemorrhage in periodontal tissue. M, bone marrow.

more compressed than normal. Within twenty-four hours the periodontal space began to enlarge as a result of resorption of bone, continuing to enlarge until the normal physiologic thickness of the periodontal tissue was reestablished in these areas. The rapidity of bone resorption appeared to be dependent on the age of

the animal, being more rapid in the young than in the old. On the opposite side, the effect of tension on the alveolar and supporting bone was also apparent within twenty-four hours. Rapid bone building occurred on the alveolar wall from which the tooth was moving. Areas of necrosis and undermining resorption were found where excessive stress had caused damage to the periodontal tissue. The experiments demonstrated that teeth of animals will move under continued occlusal stress into new positions, and that the periodontal tissue and supporting bone are soon readjusted to accommodate the new requirements. In no cases were the teeth of the dogs permanently loosened by the changed occlusal relations, but the teeth were displaced to a new position, in which the normal relation of tooth, periodontal tissue and bone were soon reestablished.

Orban and Weinmann[11] made further studies of human teeth to determine the significance of abnormal and excessive occlusal stress in the etiology of pyorrhea. They found evidence of trauma in almost every jaw where teeth had been extracted and had not been replaced. These traumatic injuries were similar to those that Gottlieb and Orban had found in their experiments on traumatic occlusion in dogs. They observed hemorrhage and thrombosis of the vessels and necrosis of the periodontal membrane where the teeth were subjected to very heavy occlusal stress. No relation was apparent between gingivitis and changes in the periodontal tissue due to occlusal trauma.

Box[12] experimented on a sheep to observe the effect of excessive occlusal stress.

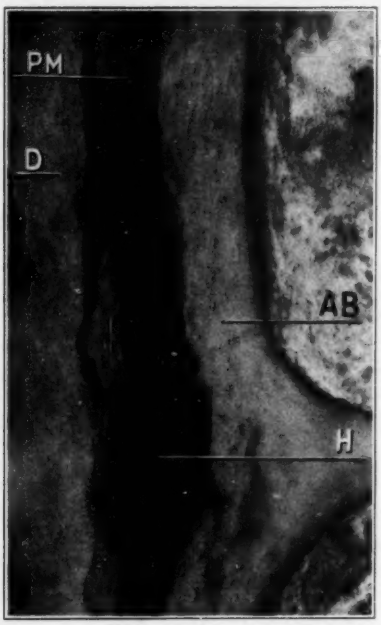

Fig. 3.—Jaw 17: Higher magnification of hemorrhagic area from Figure 2. D, dentin. AB, alveolar bone. PM, periodontal membrane. H, hemorrhage.

Fig. 4.—Jaw 17: Small area of periodontal tissue of lower right first permanent molar showing side of pressure, with thrombosis of blood vessels. D, dentin. AB, alveolar bone. PM, periodontal membrane. P, periosteum. BV, thrombosis of blood vessels.

Fig. 5.—Jaw 17: Section of upper right first permanent molar in area of bifurcation. D, dentin. AB, alveolar bone. PM, periodontal membrane. C, cementum. OC, osteoclasts resorbing alveolar bone on distal slope of bifurcation, indicating mesial drift of tooth. F, enamel of second permanent molar (unerupted). R, resorption of root of first permanent molar due to pressure of erupting second molar. This pressure probably accounts for the mesial drift of the first molar.

Fig. 6.—Jaw 17: Apex of lingual root of upper left first permanent molar. D, dentin. AB, alveolar bone. PM, periodontal membrane showing necrosis from excessive occlusal stress. M, floor of maxillary sinus.

He cemented a crown on a lower incisor to raise it above the other incisors. After 104 days, he observed an increased mobility of the crowned tooth and a slightly deepened gingival crevice around it, but no traumatic injury to the periodontal membrane. The tooth had been moved out of line by the continued excessive stress.

Euler[13] reported an experimentally pro-

duced cementum fracture in a dog's tooth. He also reported a fracture in the cementum of a human incisor, which he compared with the fracture of bone wherein a ligament or tendon is attached so firmly that a piece of bone breaks off under excessive pull of this ligament or tendon.

Urban, Beisler and Skillen[14] reported an experiment made to show tissue disturbances brought about by different degrees of force applied in separating the teeth of dogs with a mechanical separator. The separator was adjusted and force applied for a period of thirty minutes, until the crowns of the teeth were moved apart 0.75 mm., 1 mm., 1.6 mm. and 2 mm., respectively. This separation moved the teeth so that the crowns were apart, but the roots were inclined toward each other with a definite fulcrum point located near the center of the roots. This work supported the observations of Johnson, Appleton and Rittershofer, Schwarz, Gottlieb and Orban concerning the location of the fulcrum point in the root between the middle and apical thirds when heavy force is applied. Urban, Beisler and Skillen observed tearing of fibers of the periodontal membrane and fractures in the crest of the alveolar process. Crushing and necrosis of the periodontal membrane occurred on the side of pressure, with the surface of the root pressed against the alveolar process. They concluded that the damage to the periodontal tissue was due to rapid separation and that the amount of injury was in proportion to the amount of force applied, al-

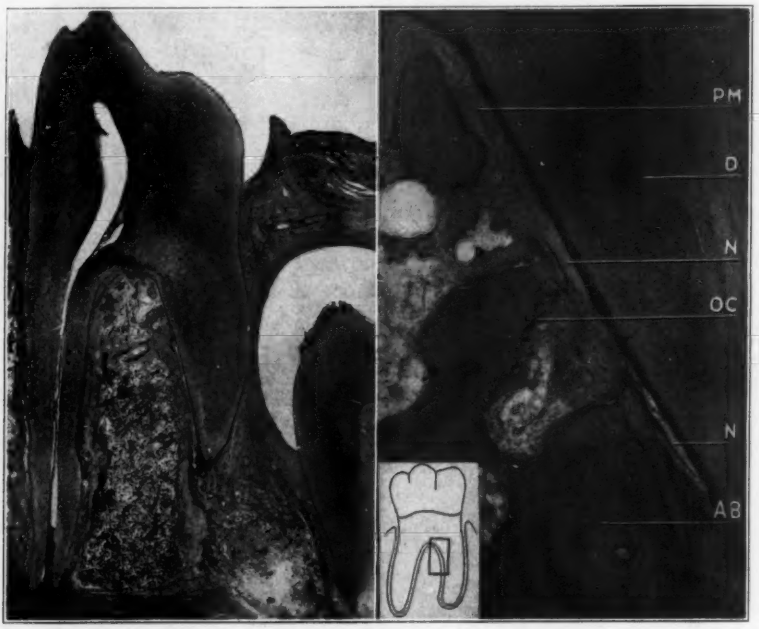

Fig. 7.—Jaw 17: Lower left first molar, with higher magnification at right, showing backward undermining resorption of alveolar bone along distal root. D, dentin. AB, alveolar bone. PM, periodontal membrane. N, necrosis of periodontal membrane. OC, osteoclasts resorbing alveolar bone from behind where periodontal membrane had been crushed.

though a distinct variation was noticed in individual tolerance and reaction to such stress.

Adrion[15] studied five human jaws, ranging in age from 25 to 79 years, in which he observed fractures of the cementum. He concluded that cementum fractures can be caused on the root surface by excessive function or by traumatic-mechanical influences. Where fiber bundles are firmly attached to the bone, the tear takes place at the dentinocemental junction. Pyorrhea is a predisposing factor in the occurrence of fractures of the cementum. He observed that the fragment which had been torn away from the root surface was suspended about equidistant from the root and alveolar bone and the periodontal space had been widened so that the intervening periodontal membrane on each side of the fragment was approximately uniform in thickness. This finding corresponds to the observation by Figg,[16] who reported a fracture of the cementum in an animal.

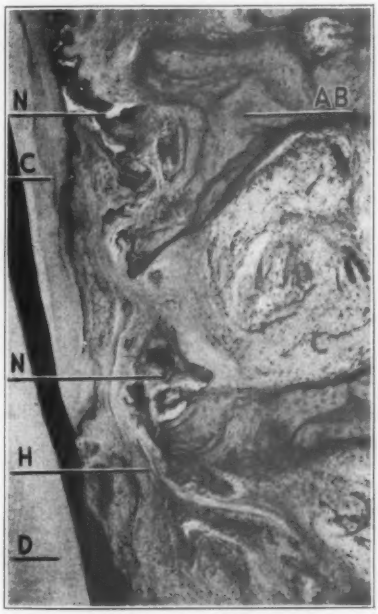

Fig. 8.—Jaw 21: Side of pressure of upper right first bicuspid in heavy function in jaw of woman aged 51. D, dentin. C, cementum. AB, alveolar bone. N, necrosis of periodontal membrane. H, hyalinization of periodontal membrane.

Traumatic injuries in the periodontal tissues of human jaws have also been reported by Kronfeld,[17] Box[18] and Grohs.[19] There is much similarity in the injuries reported. The conclusions given by these investigators are similar as to the predisposing causes as well as to the direct causes.

REPORT OF PRESENT STUDY

In the examination of many human jaws, it is possible to observe a wide range of conditions in the periodontal tissues. Minute injuries and vascular disturbances are not easily interpreted. The evidence of gross injuries is less frequent, but these injuries are more easily seen. However, many areas showing but little damage may be observed and studied.

The periodontal tissue of fifteen human jaws was studied. Roentgenograms were available of all teeth, and plaster casts mounted on articulators furnished a fairly accurate picture of the occlusal relations of the teeth of each jaw. Jaws in which many teeth were missing furnished the most frequent evidence of traumatic or functional injuries in the periodontal tissue of the remaining teeth, on which the entire stress of the occlusal forces was brought to bear. However, some jaws containing most of the natural teeth presented areas where injuries were present. These injuries may be placed in two groups: (1) minor injuries, such as hemorrhage, thrombosis and hyalinization of the periodontal membrane, and abnormal bone resorption, and (2) gross injuries such as necrosis of the periodontal tissue, root resorption and fractures of the cementum. Variations in thickness of the periodontal tissue around individual teeth on the side of pressure and on the side of tension were usually present. Many

areas of repair were observed where resorptions had resulted from traumatic injuries but were in the process of restoration.

In the jaws of a boy of 11 years who died of scarlet fever, many interesting observations were made. The central and lateral incisors and first permanent molars were in position. The deciduous cuspids and molars were present on the right side, but on the left side the occlusion was supported only by the first permanent molars and lateral incisors. (Fig. 1.) The deciduous mandibular second molar was present, but the deciduous maxillary molars were missing.

The traumatic injuries were of such long standing that only a few areas could be found where recent hemorrhage had occurred and erythrocytes could still be seen in the tissue. Figure 2 shows such an injury, which must have been caused by heavy pressure preceding death, perhaps when the boy ground his teeth together in an effort to find some position in which the lower deciduous second molar would come in contact with the upper permanent molar. A higher magnification of the area is shown in Figure 3.

Thrombosis of the blood vessels was found in the periodontal tissues in numerous places. Figure 4 shows a thrombosis on the side of pressure of the lower right first permanent molar. The thickness of the periodontal tissue is greatly reduced by compression as the root is nearly in contact with the alveolar bone. Such injuries as are shown in Figures 2, 3 and 4, functional or traumatic, are of the first degree. It may have been a lowered resistance due to the scarlet fever that rendered the local tissue more susceptible to injury at this particular time. It seems unlikely that such injuries could

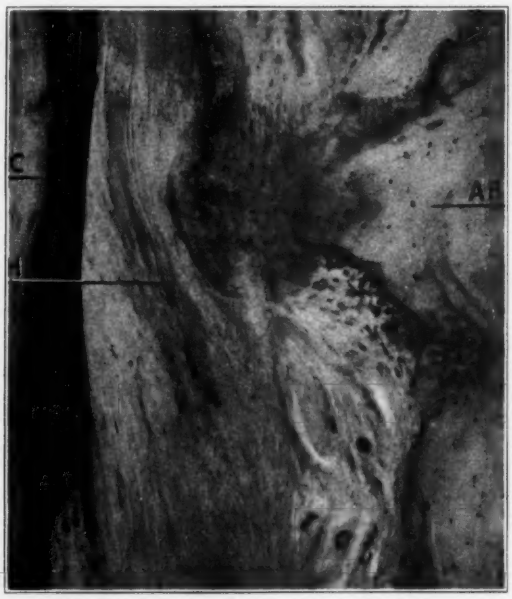

Fig. 9.—Jaw 21: Higher magnification of area of hyalinization of Figure 8. C, cementum. AB, alveolar bone. H, hyalinization of periodontal membrane.

have been caused in normal health by a sudden closure of the jaws with excessive force. Had the patient survived, it is quite probable that these injuries would have been rapidly repaired.

In Figure 5, there is evidence of excessive pressure in the bifurcation of the upper right first molar with osteoclastic resorption progressing along the alveolar wall on the distal slope of the septum. The tooth was subjected to heavy occlusal stress while a mesial drift was underway to accommodate the eruption of the upper second molar, the enamel of which can be seen in contact with the root of this tooth. A slight resorption had occurred in the dentin where the contact has now crushed the periodontal tissue.

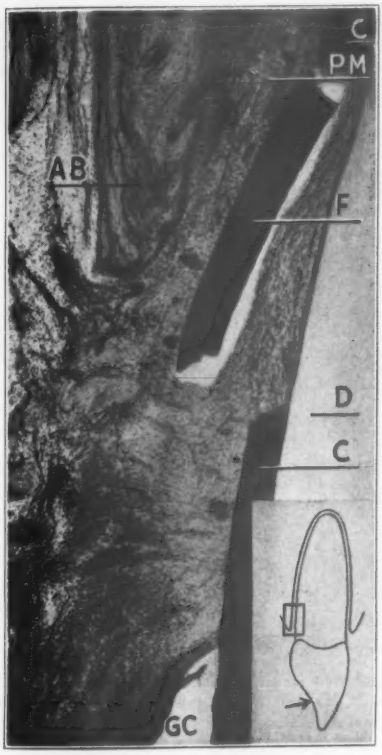

Fig. 10.—Jaw 21: Fracture of cementum on upper left central incisor on side of tension (direction of force indicated by arrow). D, dentin. C, cementum. AB, alveolar bone. PM, periodontal membrane. F, fragment of cementum torn loose. GC, gingival crevice.

The upper left first molar has an area of necrosis in the periodontal tissue at the apex of the lingual root (Fig. 6), where it has been crushed by an excessive occlusal stress. It appears that the tooth was suddenly driven up in its alveolus until the apical periodontal tissue on the lingual root was crushed. The stress from this molar occluding with the lower deciduous molar caused hemorrhage in the periodontal tissue of the latter.

In Figure 7, an area of necrosis with backward resorption is seen in the periodontal tissue of the lower left first molar. Osteoclasts are arranged along the sides of the alveolar bone where the periodontal tissue lying between the cementum and alveolar bone has been crushed or hyalinized. All cells have disappeared because the root had been forced against the alveolar bone and has crushed the intervening soft tissue.

A bicuspid in heavy function from the same jaw shows necrosis of the periodontal tissue from crushing. (Fig. 8.) Here, both cementum and alveolar bone show resorption and the alveolar process has been resorbed in many places, the periodontal space enlarging so that the periodontal tissue communicates with the adjoining narrow spaces.

An area of hyalinization of the periodontal tissue in the jaw of a woman 51 years of age is shown in Figure 9. Here, on the side of pressure, the periodontal tissue was continuously injured but not destroyed. Cell nuclei have disappeared from the remaining degenerated tissue.

In Figure 10, the cementum is fractured from the lingual surface of an upper left incisor. Since only a few teeth remained in function in this woman's jaw, this tooth received excessive stress. The periodontal space became widened on the side of tension, and since the periodontal

tissue would not stretch or yield sufficiently under occlusal stress, the cementum was pulled away from the dentin. Such fractures are quite common in jaws of this type where the support of the tooth has been weakened by disease (pyorrhea). Fractures in the cementum have been shown by Figg, Euler, Adrion, Grohs and others.

A repaired injury and one in the process of repair can be seen in Figure 11. In this jaw, where occlusal conditions had become changed, this tooth was no longer subjected to an excessive stress, and repair was complete in one area and well started in the other resorbed area. Had the patient lived longer, it is quite probable that this beginning repair also would have been completed.

The jaws from a man 54 years of age contained many interesting conditions for study. Only a few can be presented. The lateral incisors of the upper jaw had been ground down to carry a bridge which replaced the missing upper central incisors. The study of the lower incisor teeth which had been in contact with the bridge revealed fractures of the cementum at the apices of the roots.

Figure 12 is the full view of the lower left central incisor. A thin alveolar process extends up two-thirds of the length of the root. The periodontal space at the alveolar crest is wide on the labial side of tension, and narrow on the lingual side of pressure. This shows that the tooth was under heavy stress on the labial surface of the crown. At the apex, the periodontal space has been widened by resorption and a large fracture in the cementum is seen on the lingual surface (side of tension). This widening of the

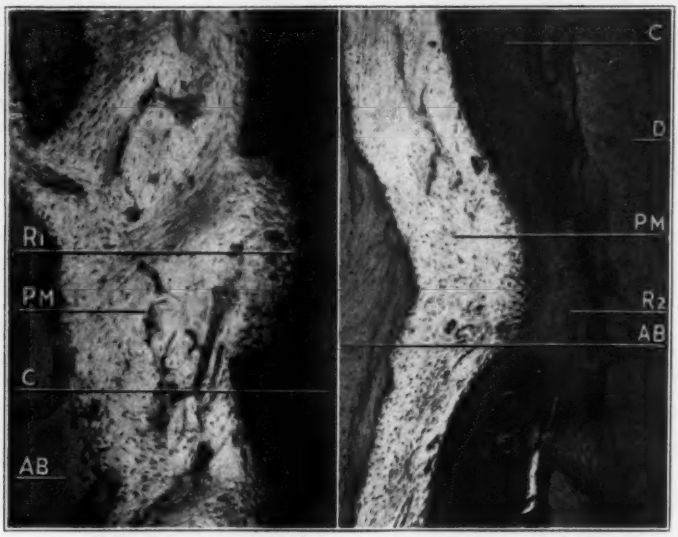

Fig. 11.—Jaw 21: Upper right central incisor, side of pressure. Left, beginning repair of resorbed area on root surface. Right, completed repair. D, dentin. C, cementum. AB, alveolar bone. PM, periodontal membrane. R1, repair in progress. R2, repair completed. A difference in thickness of the periodontal membrane at left and at right, after repair is completed, is evident.

periodontal space and fracture of the cementum occurred on the lingual side at the apex, whereas the side of pressure at the crest of the alveolus was located on the lingual side. The side of pressure at the apex is opposite the side of pressure

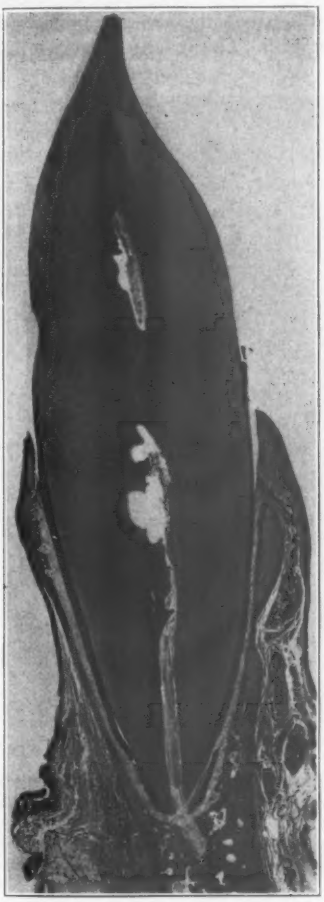

Fig. 12.—Jaw 35: Lower left central incisor of man aged 54. Excessive stress on the labial surface had tipped the tooth lingually. Fractured cementum can be seen in the lingual apical region, on the side of tension at the apex.

at the alveolar crest; which indicates a fulcrum point higher up on the root and not at the apex in response to the force exerted on the tooth in mastication.

A higher magnification in Figure 13 shows the fractured cementum lying free in the periodontal space with periodontal tissue on each side of it. The splinter is almost completely covered with new cementum deposits and so is the dentin from which the splinter was fractured. It is evident from the stage of the repair that the injury occurred sometime previous to death, since such repairs require time for completion. Kronfeld[20] reported a case of repair wherein the different stages of early repair could be observed at different levels of the fracture. It can also be observed in Figure 13 that the root surface had been resorbed on the side of pressure at the apex (labial). Lacunar resorption had removed much old cementum, now restored by new deposits. This displacement of the apical foramen can be seen. There has been a tendency to straighten the path of the vessels and nerves as they enter the apical foramen of the root canal by new deposits of cementum in one side along the canal wall.

The right lateral incisor apex is shown in Figure 14. Here, the fractured cementum appears on the side of pressure (labial). The repair process is well underway and the splinter is partially united again with the root surface by new deposits of cementum. Had the splinter been on the other side of the root, we should have expected it to remain free in the tissue as in Figure 13, but here the space between the root surface and alveolar wall is narrower than on the side of tension. Repair is rapidly closing the gap between the splinter and the root surface. The cause of this fracture can only be guessed at, since it is on the side of pressure. Some factor in occlusion may have reversed the direction of force at the time this fracture occurred. The position of the apical foramen in relation to the opening in the alveolar bone for the passage of blood vessels and nerve tissue would show that the occlusal pressure at

the time of death was on the labial surface, having inclined the tooth slightly in a lingual position.

In Figure 15, the left central incisor of a man 50 years of age is shown. The incisor protruded labially, and slightly overlapped the right central incisor. Formation of a deep pocket on the lingual surface had resulted in considerable loosening of the tooth. Fractures of the cementum in the apical region are found on both labial and lingual surfaces of the root. Repair has occurred on the labial surface of the root and the splinter lies midway between the root surface and the alveolar bone, with organized fiber bundles of the periodontal tissue attached on each side. This finding, which is similar to that reported by Figg and Adrion, shows that there is an attempt by Nature to reestablish a normal periodontal width on each side of the splinter, which is held in position by periodontal fibers suspending it between the alveolar bone and the cementum. The fractures on the lingual surface have not been repaired and there is little evidence of repair in progress.

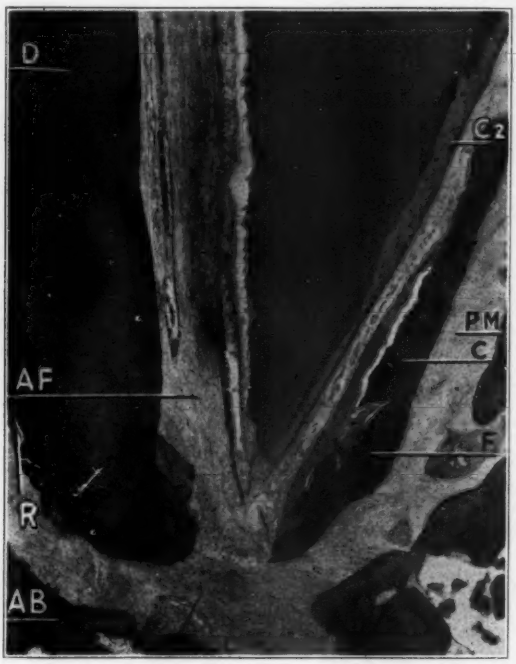

Fig. 13.—Jaw 35: Higher magnification of apex of incisor shown in Figure 12. D, dentin. C, old cementum. C2, new cementum. PM, periodontal membrane. AB, alveolar bone. R, resorbed area on side of pressure repaired by new cementum. F, fractured cementum lying free in periodontal membrane on side of tension. AF, apical foramen showing cementum deposited to compensate for divergence of teeth from channel accommodating pulp vessels entering root canal.

SUMMARY

Histologic study of the periodontal tissues of fifteen human jaws revealed many functional or traumatic injuries.

Abnormal or excessive functional stress resulted in pathologic changes in bone, periodontal membrane and root surfaces.

These pathologic changes are similar to those that have been produced with orthodontic appliances in experiments on the teeth of animals in which an excessive amount of force was applied. These changes may be summarized as hemorrhage, thrombosis, hyaline degeneration and necrosis of the periodontal tissue, excessive bone resorption, root resorption and fractures of the cementum from the root surfaces.

seems to indicate that damage in these tissues is more readily repaired in the young than in the old.

Traumatic or functional injuries are soon repaired and return to normal. Resorbed areas of bone and cementum are covered over by new deposits of hard tissue when changes in the occlusal relations relieve the excessive stress.

Where the periodontal tissue is continuously traumatized but not entirely destroyed, degeneration occurs in the form of hyalinization of this tissue.

Traumatic injuries which result in

Fig. 14.—Jaw 35: Apex of lower right lateral incisor. D, dentin. AB, alveolar bone. PM, periodontal membrane. C1, old cementum. C2, new cementum. F, fractured cementum partially repaired. AF, apical foramen. The position of the apical foramen in relation to the channel in the alveolar bone indicates that the fractured cementum in this case is on the side of pressure and is being reattached by new deposits of cementum.

Pressure resorption areas in the alveolar bone were found on opposite sides of the root at the cervical and apical areas, indicating location of a fulcrum somewhere between the apex and the midroot.

Age does not seem to be a factor in the susceptibility of the periodontal tissues to excessive stress, but clinical observation

fracturing splinters of cementum from the root surfaces occur more frequently in teeth the supporting structures of which are weakened so that the tooth can move beyond its normal functional limit when sudden excessive stress is applied.

Splinters of cementum that become fractured from the root surfaces are usu-

ally accommodated by an increase in the thickness of the periodontal tissue to allow the splinter to become suspended between the alveolar bone and the root surface, if they are not reunited to the root surface by new cementum deposits before they drift away.

CONCLUSIONS

Functional and traumatic injuries of the root and periodontal tissues resulting from abnormal or excessive stress in human jaws are similar to the experimental injuries produced in corresponding animal tissues.

These injuries in the periodontal tissue of human teeth appear to heal readily when the abnormal or excessive stress is relieved. However, if the reparative power of the tissue is overtaxed by repeated insults over a long period of time, the unrepaired damage might lead to periodontal disease and loss of the tooth.

A normal stress may become excessive when the capacity of a tooth to withstand heavy stress is reduced by lowered resistance or by loss of the supporting structure.

A tooth with a weakened alveolar support is more susceptible to fracture of the cementum than one with a normal support.

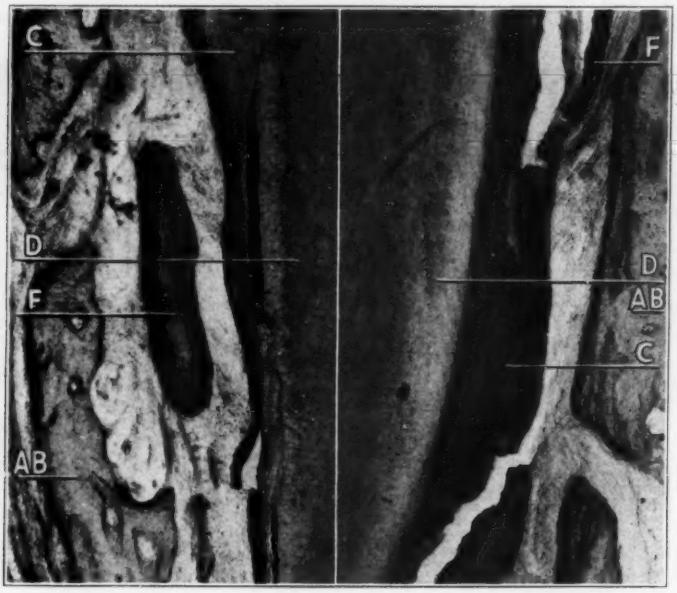

Fig. 15.—Jaw 20: Apical area of upper left central incisor from jaw of man aged 50; protruding tooth with deep pyorrhea pocket on lingual surface. Left, apical area on labial side. Right, apical area on lingual side. D, dentin. AB, alveolar bone. C, cementum. F, fragment of cementum suspended midway between bone and root. Fractures on the other surface are unrepaired.

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PROLONGED RETENTION: WHEN SHOULD HEALTHY DECIDUOUS TEETH BE EXTRACTED?

By George E. Morgan, D.D.S., Milwaukee, Wis.

PROLONGED retention of the deciduous teeth is a field of study much neglected by the dental profession and especially by those interested in pedodontia. The general trend of thought has been that Nature has the miraculous power of doing the right thing at the right time even when it comes to the timely exfoliation of the deciduous teeth. Today, we know that Nature is not so kind and that a satisfactory dental health service cannot be rendered children unless the dentist is able to determine whether a healthy deciduous tooth should be extracted.

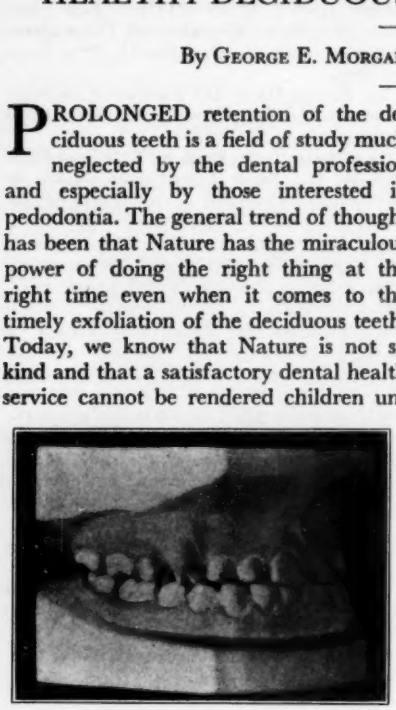

Fig. 1.—Prolonged retention of upper right deciduous cuspid and ectopic eruption of permanent cuspid.

Not many years ago, prolonged retention of the deciduous teeth was not diagnosed by the dentist until the succeeding permanent tooth had erupted either buccally, lingually or labially to the deciduous tooth (Figs. 1 and 2); which was no earlier than the layman recognized the abnormality. Some dental practitioners have thought that all deciduous teeth should be extracted when the child reaches a certain age, if all the permanent successors are present, regardless of the individual tooth resorption and development. Others believe that if a deciduous tooth on one side is exfoliated, the corresponding tooth on the opposite side in the same arch as well as the opposing deciduous teeth in the other arch should be extracted without individual tooth consideration. These methods of determining when healthy deciduous teeth should be extracted should not be practiced.

Fig. 2.—Deciduous cuspid area shown in Figure 1.

With the roentgen rays now playing such an important rôle in everyday dental service, it would not seem difficult for any dentist to determine when healthy deciduous teeth should be removed in order to prevent prolonged retention,

(Read before the Section on Children's Dentistry and Oral Hygiene at the Seventy-Ninth Annual Session of the American Dental Association, Atlantic City, N. J., July 14, 1937.)

which so often results in ectopic eruption of the permanent successor. We know that deciduous teeth are to serve during an important period of growth and development and for a certain length of time, depending on the individual child. We know too that the process of growth and development varies in children as much as individuals themselves vary. We also know that individuals do not develop with the same amount of rapidity or uniformity on both sides of the body. For example, the right arm of the right-handed person is better developed than the left arm. Likewise, the right side of of the child's jaws may be better developed than the left, especially if the child masticates more on that side.

Fig. 3.—Prolonged retention of second deciduous molar due to lack of uniformity in resorptive process. (Case A.)

The main reasons for the prolonged retention of the deciduous teeth may be classified into three distinct divisions: (1) incomplete resorption of one or more roots or a portion of a root of the same deciduous tooth as a result of a lack of uniformity in the resorptive process; (2) delayed development or complete absence of the permanent successor, and (3) lack of coordination between the intermittent process of resorption of the deciduous tooth and the forces of development and the impulse of eruption of the permanent successor.

Therefore, if we have synchronization of all of these forces, we have exfoliation of the deciduous tooth at the proper time, followed immediately by the eruption of the permanent tooth.

The above-mentioned divisions can better be elaborated by citing a few cases:

Division 1.

Case A.—A girl, aged 11, had all erupted permanent teeth in normal alinement, including three of the second bicuspids. The only remaining deciduous tooth was the lower left second deciduous molar. This tooth appeared somewhat raised above the occlusal plane and yet on movement seemed very firm. The gum around the tooth was pink and healthy in appearance.

Roentgenographic examination showed that the mesial root of the lower left second deciduous molar was completely resorbed; whereas only a small fraction (that portion

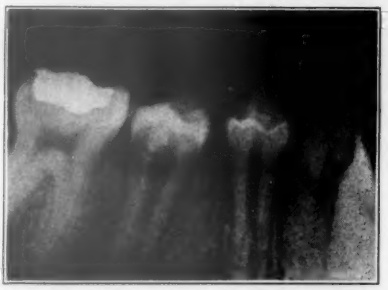

Fig. 4.—Deciduous root fragment embedded in jaw owing to lack of uniformity in resorptive process, with prevention of normal proximal contact.

nearest the crown) of the distal root showed any signs of resorption. The apical end of the distal root had taken on a senescent appearance. The succeeding bicuspid, in its effort to erupt, was drifting mesially, which may have had some effect on the failure of the distal root to resorb. (Fig. 3.) However, this is very doubtful because the process of resorption varies with individuals and a definite theory cannot be evolved in any given case. Under these conditions, the second deciduous molar could not under any circumstances be exfoliated normally and must be carefully extracted to make certain that the distal root is removed.

Frequently, in cases as shown in Figure

3, when the distal root is not completely removed because of fracture at the point of resorption, the apical portion of the root remains embedded in the jaws. In such cases, the first permanent molar is prevented from drifting mesially, as it normally does, to position itself correctly in occlusion, and the contact between the mesial surface of the first permanent molar and the distal surface of the second bicuspid is lost.

In mouths where the permanent teeth

Fig. 5.—Impaction of bicuspid due to prolonged retention of deciduous molar.

Fig. 6.—Prolonged retention due to incomplete resorption of both roots in deciduous molar. (Case B.)

are not in contact, even though the deciduous teeth were apparently exfoliated normally, and food is lodging in the interproximal spaces, it is advisable to roentgenograph the area for remaining fragments, especially if all other contacts are normal. (Fig. 4.)

When a healthy deciduous tooth with incomplete resorption of one or more roots or a portion of a root is not extracted at the first indication of prolonged retention, the succeeding permanent tooth, owing to the impulse of eruption, becomes impacted. (Fig. 5.) This condition is more common in the upper teeth than in the lower. What the reasons are I do not know. Presumably, the tooth must erupt, and moves toward the weakest point of resistance.

Case B.—A boy, aged 12, was given periodic dental health service for approximately eight years. On observation of the exfoliation of the deciduous teeth and the eruption of the permanent teeth, it was very evident that both eruption and exfoliation were taking place with a marked degree of normalcy except in the case of the lower right second deciduous molar. The corresponding decidu-

Fig. 7.—Prolonged retention of second deciduous molar causing rotation of second bicuspid.

ous teeth were lost just prior to the last visit to the office three months previously. Owing to the fact that the exfoliation had been normal in all the other deciduous teeth, the presence of the lower right second deciduous molar did not cause any alarm, and the patient was dismissed for another period of three months, or less if the tooth were to exfoliate. Incidentally, patients are instructed to return for an examination of the mesial surface of the first permanent molars immediately after exfoliation of the second deciduous molars, regardless of whether the last visit was a week, a month or two months previous.

When the deciduous tooth was not lost within three months, a roentgenogram showed that both the mesial and the distal

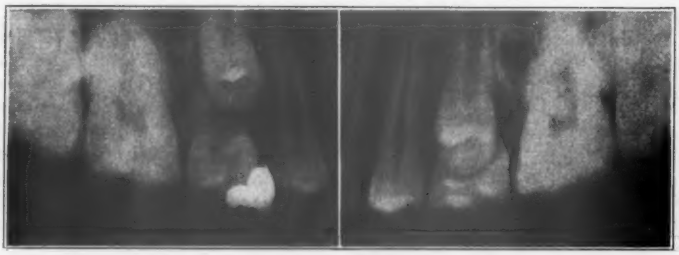

Fig. 8.—Left: Delayed development of second bicuspid. Right: Prolonged retention of second deciduous molar. (Case C.)

Fig. 9.—Left: Prolonged retention of second deciduous molar due to congenital absence of bicuspid. Right: Normal exfoliation of second deciduous molar followed immediately by eruption of bicuspid. (Case D.)

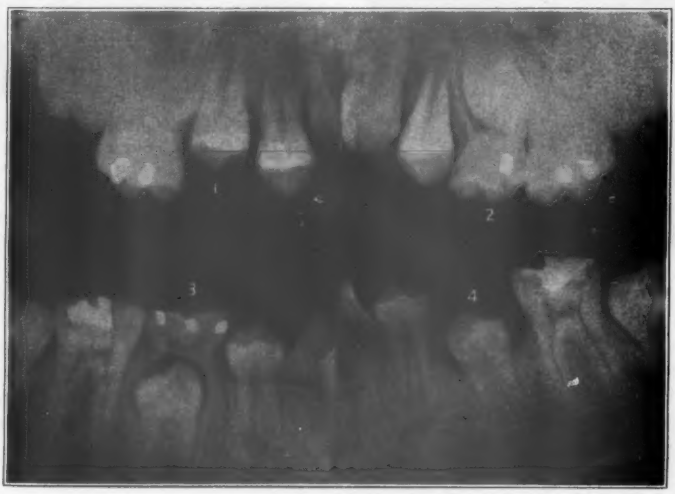

Fig. 10.—Case E.

roots had not been resorbed. However, resorption had been slightly active in the area nearest the bifurcation of the roots. The succeeding permanent tooth had developed normally and appeared to be striving to erupt. (Fig. 6.) The deciduous tooth was extracted

and the permanent tooth was just below the crown of the deciduous predecessor.

If resorption of both the mesial and the distal roots is incomplete and the deciduous tooth is not extracted at the proper time to allow the permanent tooth to erupt, the succeeding permanent tooth, owing to the impulse of eruption, tends to rotate rather than erupt buccally or lingually to the preceding deciduous tooth. (Fig. 7.) This may be accounted for by the fact that, in its effort to find the point of least resistance, it begins rotating and often turns completely around, since the roots of the deciduous tooth, by their conelike enclosure, have a tendency to hold the permanent tooth upright.

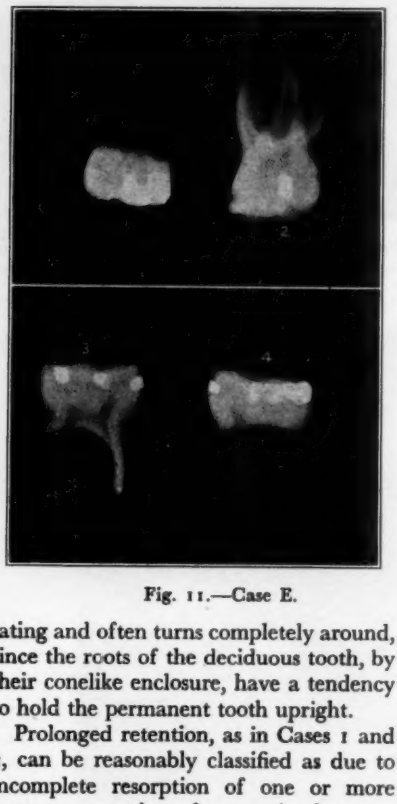

Fig. 11.—Case E.

Prolonged retention, as in Cases 1 and 2, can be reasonably classified as due to incomplete resorption of one or more roots or a portion of a root in the same deciduous tooth as a result of a lack of uniformity in the resorptive process.

Division 2.

Case C.—A girl, aged 14, had a high degree of immunity to dental caries, the only restoration in the complete denture being a mesioclusal amalgam filling in the upper left second deciduous molar. This had been placed eight years previously and appeared in excellent condition. The upper second deciduous molars were the only remaining deciduous teeth in the jaw. Roentgenograms showed that the upper right second bicuspid had developed in advance to the upper left second bicuspid. (Fig. 8.)

The roentgenogram on the right in Figure 8 shows a relation between the resorption of the roots of the second deciduous molar and the development of the bicuspid. The one on the left shows harmony between the resorptive and the development process. But when we realize that these conditions exist in the same individual and make a comparison of one side with the other, we see that the right side indicates prolonged retention, while the left side shows delayed development. Therefore, it is evident that the delayed development of the upper left second bicuspid does not warrant the extraction of the upper left second deciduous molar, but the healthy upper right second deciduous molar should be extracted.

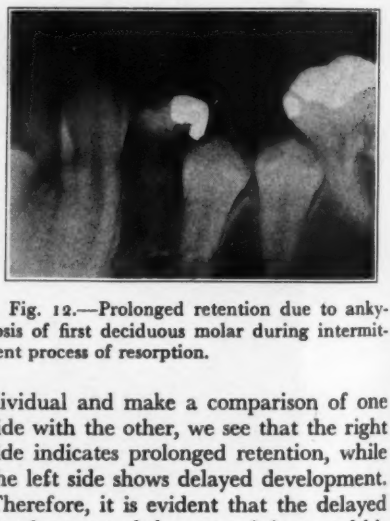

Fig. 12.—Prolonged retention due to ankylosis of first deciduous molar during intermittent process of resorption.

Case D.—A girl, aged 12, had a normal exfoliation of all the deciduous teeth with the exception of the upper left second deciduous molar. This tooth was entirely free from caries and seemed slightly submerged in the jaw. A roentgenogram, which was im-

mediately taken, revealed a congenital absence of the upper left second bicuspid. (Fig. 9.)

In this case, it was evident that all healthy deciduous teeth should not be extracted to prevent prolonged retention. Oftentimes, as in the case of congenital absence, Nature prevents the normal exfoliation of a tooth with a congenitally absent successor.

What accounts for the lack of resorption of the roots of this tooth cannot be definitely shown. However, one would be tempted to conclude that the permanent successor does play a rôle in root resorption. When a healthy deciduous tooth has no permanent successor, and if the resorptive process remains inactive, the deciduous tooth may serve for a lifetime.

In Cases C and D under Division 2, the prolonged retention is attributed to the fact that we have delayed development or complete absence of the permanent successor.

Division 3.

Case E.—A girl, aged 10, on mouth examination, showed a normal exfoliation of the upper left and the lower right second deciduous molars. The upper right and lower left second deciduous molars, the only remaining deciduous teeth, were still firm in the jaws.

The roentgenographic examination revealed that the mesial root of the lower left second deciduous molar was not resorbed, but the succeeding second bicuspid showed normal tooth development, with the force of eruption at its height of activity, as the bicuspid appeared to be growing upward and showed every indication of erupting in normal position. The upper right second deciduous molar showed no resorption and the erupting succeeding tooth, owing to the forces of eruption, had begun to rotate the upper right second bicuspid. (Fig. 10.)

It is my opinion that the condition of both these teeth indicates prolonged retention, and the extraction of the offending healthy deciduous teeth is warranted to prevent malocclusion and allow the permanent successors to erupt during the period when the impulse of eruption is at its height. Roentgenograms of the extracted and the normally exfoliated deciduous teeth (Fig. 11) more clearly illustrate the amount of resorption.

Case F.—A girl, aged 12, was referred for pedodontic appliances. On oral examination, it was found that the lower right first deciduous molar was the only remaining deciduous tooth in the mouth. There was no evidence of the eruption of the bicuspids in the lower right side. The lower right first permanent molar had drifted mesially so that there was normal cusp relationship between the upper and lower first permanent molars. The mother stated that no deciduous tooth had been extracted prematurely. Roentgenograms showed that a portion of the mesial root of the first deciduous molar was not completely resorbed, with the result that the first deciduous molar became ankylosed in the jaw during the intermittent process of resorption. (Fig. 12.) In the effort of the first bicuspid to erupt, the second bicuspid became impacted. Normally, the first bicuspid should erupt about a year before the second bicuspid.

It is reasonable to assume that the prolonged retention in Cases E and F was due to the lack of coordination between the intermittent process of resorption of the deciduous teeth and the forces of development and the impulse of eruption of the permanent successors.

While most of the cases cited here are in the posterior region of the mouth, I am not unmindful of the fact that prolonged retention exists in the anterior region as well. However, I believe that prolonged retention of an anterior tooth is more easily diagnosed. In the past, more stress has been placed on premature loss than on prolonged retention of the deciduous teeth as a factor in malocclusion. The time has come when we should recognize the fact that we cannot always leave the exfoliation of a healthy deciduous tooth to Nature, but must treat each tooth of each child as an individual problem.

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UNDERGRADUATE INSTRUCTION IN PERIODONTIA

By W. C. Graham, D.D.S., F.A.C.D., Columbus, Ohio

ARE we to formulate a course of study in periodontology? Shall it be that we are to correlate it with other related subjects in dentistry? Shall the subject be the number of hours that should be given? Or its place in the curriculum?

DEFINITIONS

It might be well to define our subject that we may all have one basis for thought in our study.

There are three aspects of dental education: 1. Undergraduate instruction, the phase aiming at preparing men and women for the general practice of dentistry. 2. Graduate instruction; i.e., advanced training for those preparing to become specialists, teachers or research workers. 3. Postgraduate instruction, training which aims at keeping the dentist up with the times.

If these definitions are correct, we are concerned today with that phase of education which prepares men and women for the general practice of dentistry.

The definition of dentistry has changed somewhat since Chapin Harris defined it in 1867, when he said: "Dentistry is dental surgery, embracing everything pertaining to the treatment and replacement of the loss of the natural *teeth*."

Dorland defines dentistry as "the surgery and therapy of the teeth." He defines "cosmetic dentistry" as "the repairing and filling of decayed or broken teeth with such materials and in such a manner as to conceal the dental work and restore the part to a natural appearance." He defines "operative dentistry" as "that branch of dentistry which deals with the operations or manipulations in the mouth of a patient, as distinguished from those performed in the workshop or laboratory."

Anthony defines dentistry as "the science and art which treats of the teeth and contents of the oral cavity, from the surgical and therapeutic standpoint."

Dunning and Davenport define dentistry as "that department of medical science and art which is concerned with the prevention, diagnosis and treatment of diseases of the teeth and adjacent tissues, and the restoration of missing dental and oral structures."

If these definitions reflect the viewpoint of their respective times, dentistry has passed from the consideration of the teeth to the consideration of all of the tissues of the oral cavity.

While the dictionary of 1867 does not mention periodontia, Dunning and Davenport, the latest dental dictionary, defines periodontia as "that branch of dentistry devoted to the study, prevention and treatment of diseases which affect the supporting tissues of the teeth."

The *Journal of Periodontology* covers many oral diseases which are not diseases of the periodontium. Where does the field of periodontia begin and end, and where does the field of the oral surgeon or oral physician begin and end? It would

(Read before the Section on Periodontia at the Seventy-Ninth Annual Session of the American Dental Association, Atlantic City, N. J., July 14, 1937.)

simplify the work if the periodontist would not go any farther than the periodontium; yet he does go beyond it constantly, and we must give consideration to that fact.

Dentistry was originally divided into (1) mechanical and (2) operative dentistry. We no longer use the word mechanical, but speak of prosthetic dentistry, its field served through full denture, partial denture and crown and bridge prosthesis. With the exception of some studies or activities which supply information about the materials used in the mechanical aspect of dentistry, such as metallurgy, no other subsidiary studies are embraced.

Not so with operative dentistry. It seems that, by common consent, everything not embraced in the mechanical art is classified under operative dentistry, and, as a result, we have such phases of dentistry as orthodontia, exodontia, radiodontia, therapeutics and periodontia.

The term "operative dentistry" is so inadequate that it seemed advisable to seek a more suitable term. Most of the other words have a Greek origin and the new term should also have a Greek root. Dr. Boling, head of the department of classical languages in Ohio State University, suggested the word "odontoeatrics," meaning the health of the teeth. I had sought a word that would represent the operation of replacing a segment of a tooth. I was not satisfied with the term suggested and, in a seminar hour in periodontia, expressed hope that some student would evolve a word. A student wrote to Dr. Harmon, head of the department of classical languages at Yale University, and the answer came back that Dr. Boling's word was good, but perhaps the word "odontoanaplastia" might be better. I leave these two words for your consideration.

THE EXPANDING FIELD OF DENTISTRY

The older concept of restorative dentistry is obsolescent, and the task of the dental college has widened immensely, so that the graduate of even ten years ago, unless he has had some incentive, hardly realizes the scope of instruction now assumed by the dental educator. We hear of the great advancement of dentistry, but when such statements are made, we can generally assume that the speaker has in mind the x-rays, casting methods, silicate cements or balanced occlusion. These mark advancements, but merely in operative methods, which, like their predecessors, are employed in an effort to prevent caries, which, according to the records, is more prevalent today than ever before. But the greatest advance has been made along other than technical lines. Dentistry does not consist in extracting teeth, in restorations or replacing lost parts: dentistry is a health service. There is a reason for restorations, and when the profession began to realize that the art of filling teeth and replacing teeth was not enough, that the foundations must be conserved, periodontia came into existence. This does not mean that no notice had been taken of the soft structures around and near the teeth, for we read of inflammation of the mouth in very early recorded history.

In the work of preparation of a course of study in dentistry, a questionnaire was sent to 455 dentists not dental teachers, from which 250 replies could be tabulated. The questionnaire concerned fourteen major classifications under which diseases, disorders and deformities were listed. Of the 178 listed, ninety-three belong to that phase of dentistry which is embraced under periodontia and comes within the scope of this paper. It would be unwise to present a scheme for undergraduate instruction on the treatment of all those conditions named, and in addition there are other phases of disease, disorders and deformities which belong to dentistry or periodontia and general medicine conjointly. No hard and fast rule

can be given that periodontia can go so far and no farther.

Of those conditions which fall within the field of this paper and treatment of which should be taught to the undergraduate are the following, which have such a close relationship to the diseases affecting the periodontium that the undergraduate must correlate them with the health of the mouth in general:

Alveolar abscess
Abscess within the sinus
Residual alveolar infection
Granuloma
Traumatic gingivitis
Metallic gingivitis
Acute ulcerative gingivitis
Pericementitis
Hypertrophy of the gums
Atrophy of the gums
Denuded cementum
Absorption of the cementum
Hypercementosis
Root resorption
Periodontoclasia
Atrophy of the alveolar process
Hypertrophy of the alveolar process
Pericemental abscess
Malignant tumors
Benign tumors
Cysts
Odontoma
Cellulitis
Osteomyelitis
Osteoporosis (rarefying osteitis)
Necrosis of the jaw
Ankylosis of the jaw
Trismus of the jaw
Fissured tongue
Leukoplakia
Aphthous stomatitis
Ulcerative stomatitis
Inflammation of the salivary glands
Dry socket
Herpes labialis
Abnormal composition of saliva
Xerostoma
Lymphadenitis
Maxillary sinusitis
Neuralgia
Tic douloureux
Peritonsillar abscess
Sprue
Wounds of the mouth
Foreign bodies in gums
Hemorrhage
Hemophilia
Anemia
Diabetes
Leukemia
Dietary deficiencies
Autointoxication
Bacteremia
Osteitis fibrosa cystica
Tetanus
Lingua geographica
Lingua nigra
Glossitis sclerosis
Moeller's glossitis
Mycotic stomatitis
Salivary fistula
Ludwig's angina
Lupus vulgaris
Noma
Facial paralysis
Phlegmon
Actinomycosis
Polyps of the maxillary sinus
Fordyce disease
Neuropathic ulcer
Aneurysm
Ranula
Hematoma
Chickenpox
Measles
Smallpox
Scarlet fever
Typhoid fever
Nettlerash
Lichen planus
Erysipelas
Erythema
Foot and mouth disease
Pemphigus
Purpura
Agranulocytosis

Nor is this list complete. It covers most of the diseases which the dentist is supposed to know about and which are generally embraced under the subject of periodontia. Their treatment is taught either in a separate course variously named dental medicine, oral medicine or practical materia medica or is covered by the professor of periodontia.

I wonder if the general practitioner of dentistry has not thought of periodontia as in reality merely oral hygiene, and of oral hygiene as cleaning of teeth and the instruction to the patient. If the real scope of the teacher is in conformity to the definition, periodontia must be taught in every classroom, in every course in the college. If we should have a well-marked limitation in the curriculum of this subject, much of what belongs to the subject would be omitted.

If the teachers in other branches of dentistry are not to draw attention to it, yes, emphasize it, the instruction will revert to the status which prevailed when dentistry became a profession, a century ago.

Accepting, then, the fact that all teachers must emphasize the probability of departure from the normal and keep in mind that the health of the entire body is dependent on a healthy mouth, they must emphasize to the student continually the part the mouth plays in general health.

And while it is true that the technics of the different courses must be taught and mastered by the student, the reason that each particular technic is used and taught is the objective of that course. The best gold restoration or balanced occlusion does not represent good dental work if it is not based on biologic facts. Our teaching, then, of periodontia takes us

back to the predental courses, and we can see that there is a reason for the study of chemistry and physics. When we come to the strictly dental curriculum, the student is told why the tooth has its anatomic form, thereby serving a physiologic function, and that any departure from this form jeopardizes the health. The student must be given a picture of the ideal mouth, with ideally formed and placed teeth, surrounded with ideal gums or environment, including the secretions.

In most of the dental surveys so far made, the stress has been on the teeth, and notations were made as to whether teeth were missing or were carious or the restorations were of gold, etc.; but the surveys of disease conditions, with the exception of caries, have been rather limited. The newer, biologic concept of dentistry has lifted it out of the skilled craft stage of mechanics, which dominated its former existence, into a scientific stage, in which prevention, conservation, correction and cure are cornerstones, and of which prevention is the chief cornerstone.

In this transformation, the responsibilities and complexities have correspondingly increased. To meet these contingencies, greater knowledge is necessary and a broader training required, for the engineering problem is made more complex because of the ever-changing reactions of living tissues.

This transition upward came as a result of recognition of the fact that from a technical point of view, dentistry had advanced as far as it could go, and had failed to check the great loss of teeth and to maintain the oral health; for we know that more teeth had been lost through disease of the gums than through caries. Thus, the foundations of the teeth must be considered. A tooth or a number of teeth can be removed from the mouth, and while the full function of the mouth would be impaired, the remaining tissues could be brought to comparatively good health, and the body only remotely suffer; but the retention of the soft tissues in a state of dysfunction augurs disease in remote parts of the body. Through the nervous and circulatory systems, these foundation tissue structures have a close connection with the general system, and the general system has a close connection with the oral tissues, each exercising a controlling influence on the other. Thus, the newer aspect of dentistry opens up the field of general biology, and the entire body must be studied if we are to give the greatest possible help in the maintenance of mouth health.

COURSE OF STUDY IN DENTISTRY

The course of study in dentistry is not one which every teacher is bound to follow: it is only a suggested guide, and each teacher will use what he can, elucidate the points that he is best acquainted with, illustrate with what knowledge he has, make his course as fascinating as he can, interest his students all he can and arouse them to an appreciation of the great importance of periodontia. No two teachers will teach just alike, no two will be equally equipped as to mental qualifications either in knowledge or in ability to impart what they know.

Two men go through the same mountainous country. One is equipped with a knowledge and liking for geology, the other with a special liking for fine art, and although they view the same mountain ranges, their stories will differ, and their students will be affected differently. The teachers must have a guide, which the course in dentistry aims to furnish, and the teacher, like gleaners in a field, gathering here a little and there a little, of that which should be taught to his students, binds these facts in a sheaf of knowledge so attractive and inspiring that the student will like it.

There is always a feeling that one's particular work is the most important of all. The man whose field is exodontia or orthodontia thinks his specialty deserves more time than was accorded by the sur-

vey committee, and the periodontia group think the same of their work, but the course, of two preparatory years and four professional years in strictly technical work, is long. We hear complaints that it is not necessary, but if each specialty were given as much time as each teacher desires, the course would be lengthened at least one half.

We must remember that the college course is only an outline for the learning the student must get after he gets out of college. The college cannot educate the student: he must educate himself. All education is self-education, and the course is planned for the average student. Some will get more out of it than others, always. Were this thoroughly understood by the profession, so much blame would not be placed on the college.

The question may arise in the mind of some, "Would you not have a scheduled course in periodontia?" Yes. I think so. The books offered as texts today, such as Merritt's, McCall and Stillman's and Bunting's, have limited their works very largely to the diseases of the periodontium, and this would be the scope of instruction for this course, but the connection between the periodontal disease and that of the surrounding tissues is so intimate that there can be no limit to your instruction. There will be a wide overlapping with oral medicine, and this cannot be helped. The course of study in dentistry does not set apart any division and call it periodontia, but it was the idea of the committee that the subject matter would, and should, be emphasized all through the course.

The course as followed at the Ohio State University should indicate what, in our opinion a course might consist of, were it not for the uncontrolled factors which limit us. Our program is something like this.

The student having had his work in the study of pathology, both general and special, the course in prevention in dentistry is started, beginning in the spring quarter of the sophomore year, and given two hours a week. In the junior year, the course is continued, expanding from the idea of prevention to that of repair. Prevention is thought of as Utopian, but we realize that it can never be fully realized. As a consequence of our failure in prevention, we must give attention to repair.

We then introduce the student to the principles of medicine, the foundation concepts that must determine the care he gives the tissues after they become diseased. This course is called oral medicine, a separate curricular course undertaken at the beginning of the autumn quarter, and the mind of the student is directed concurrently to efforts for prevention.

The autumn quarter is devoted to the consideration of mouth lesions and the technic of oral hygiene. We speak of this as prophylaxis, but any effort at prevention is prophylaxis, the technic of cleaning the teeth and oral tissues being only one step in prevention.

In the winter quarter, we have been using Merritt's book as a guide in our study of what some call periodontology, but we consider that we have studied this subject since beginning preparatory study leading up to dentistry. Now our efforts are directed concretely to those diseases and disorders which affect the periodontium. This study ends with the winter quarter, and in the spring quarter, a seminar is conducted on the subject of periodontia.

The student, having been in the clinic from the beginning of the junior year, has seen clinical manifestations of some of the divergencies from health and the demonstrators have been instructing him on the particular case at hand. In the winter quarter, the student found out how Merritt deals with diseased periodontium. In the clinic, he is face to face with these conditions and is told to follow the text, but to read in the library the statements of others. In the seminar during the spring quarter, he relates his

efforts, asks questions and formulates in his own mind the technic he wishes to follow in such cases. Thus fortified by his own clinical experience, his knowledge of how an accepted authority would conduct the case and the helpfulness of talking over the case with his fellow students, and urged on by the teacher, he is prepared to meet the case when he is graduated.

To refer again to the suggested curriculum: It is the greatest piece of constructive curriculum building ever devised and offered to any branch of higher education, but it is not perfect. An ideal curriculum will never be devised, but this one has been a great incentive to the dental profession, and the world, to think more calmly, clearly and analytically on dental education. And when the profession has absorbed the ideas and adopted them in everyday practice, a newer and better curriculum can and will be offered and accepted as we go onward and upward to our place in the sun.

350 East State Street.

A CASE OF TIC DOULOUREUX SUCCESSFULLY TREATED BY THE USE OF TYPHOID VACCINE

By T. A. Hardgrove, D.D.S., F.A.C.D., Fond du Lac, Wis.

THE study of the neuralgia and neuritis affecting the head and face, particularly those from the fifth or trigeminal nerve, in their relation to tic douloureux, has never been so extensive as it should have been. The question of differential diagnosis of these conditions has been given little consideration.

The impression has been rather general that so-called neuralgia is not of bacterial or infectious origin. A close study of the clinical aspect of these diseases indicates that they may be of bacterial etiology. Not every affection of the trifacial nerve is a true tic douloureux. Occasionally, the development of tumors along the tract of the nerve gives rise to symptoms that are so like tic douloureux that differentiation is indeed difficult.

There may be a difference between trifacial neuralgia and tic douloureux. A trifacial neuralgia may be due to a mechanical condition or to an infection. It may be associated with certain diseases of bacterial origin, such as syphilis; or the trifacial nerve may be affected by exposure to certain weather conditions of the part through which the nerve courses.

Then there are certain types of neuralgia which seem to result from physiologic chemical changes. There is a burning type, which must be distinguished from tic douloureux; which is probably of chemical origin, and which may be but an indication of endocrine influence, since the endocrines, to a large extent, are responsible for the chemical processes of the body. However, when we have come to deal with a true type of tic douloureux, we have, in the past, been faced with the fact that the only relief we knew was heroic surgical measures, and when we afforded that relief, many times we have left the patient a cripple.

Tic douloureux is rather mildly painful in the beginnning, but as the disease progresses, the pain becomes more severe. In the beginning, it is a peripheral disease. As time goes on, it becomes more deeply seated. In the beginning, alcohol injections relieve it, but later fail to relieve it, probably because the spot on

the course of the nerve responsible for the paroxysm of pain is farther removed from the periphery.

The disease itself seems to have a dual or double nature. The Frenchman who gave it its name, *tic douloureux,* must have had a fairly good idea of the nature of the disease and must have been a close observer. The tic and the pain are two distinct things. In the treatment of this disease without surgery, the first result is relief from the pain. The tic, however, will remain for some time after. The patient will experience the tic, or jerking, as it is called, but will not have the pain. The bacteria or chemical change or virus responsible for the disease produces, I believe, in the nerve tissues, adhesions that occur farther back along the trunk of the nerve as the disease progresses.

A more or less close study of this disease has been carried on for twenty years. In examining cases over the country, it was found that, in a certain number of cases, the disease disappeared; and, in every such case, it was associated with a severe attack of some febrile disease. In many cases, the patient died of the disease, but before death he became free from the tic douloureux. One of those associated diseases was typhoid fever. It was found that those who had typhoid fever and tic douloureux at the same time were free from the latter after recovery from the fever.

Fifteen years ago, a patient in St. Agnes Hospital in Fond du Lac, Wis., who had had a most severe type of tic douloureux for twenty-five years died from typhoid fever, but from the onset of the typhoid, he was free from the tic douloureux. An effort was made throughout the country to find patients who had had typhoid fever and tic douloureux with a similar outcome. Finally, the opportunity presented itself in a bedridden patient who had had tic douloureux for ten or twelve years. She had had alcohol injections until they no longer gave relief to any great degree. It was decided to give the patient typhoid vaccine, and the result appeared to be a complete cure.

The first dose given intravenously was twenty-five million organisms; the next, fifty million; the next, one hundred and fifty million, and the last, two hundred and fifty million, at intervals of five days. No appreciable change followed the first dose, except that the patient said she thought she felt somewhat better. At the next dose, there was no great change, but the patient remarked, "That stuff is going to cure me!" Following the third dose, there was a demonstration of division of disease. The patient remarked that the pain was gone, but the jerking remained.

After the next dose, the freedom from pain continued, but some jerking remained, which, it was believed, resulted from fear on the part of the patient that the disease would return. Jerking continued for some time after the last dose, but the pain disappeared entirely, the only disturbance remaining being fear in the patient's mind that the disease would return.

A Widal test was made to determine whether the patient might have been a typhoid carrier, but the test proved negative. The fact that the Widal reaction was negative should, in my opinion, make no difference in the method of treatment with typhoid vaccine.

Several months after the vaccine was used, the tic douloureux returned. When it left, the first thing to disappear was the pain, the last thing the tic or "jerk." When the condition recurred, the first symptom noted was the tic or jerk, the next the pain. The disease again took on all the characteristics of the disease as it existed before subsidence.

In the second therapeutic effort, a slightly different method was used. After the patient received an injection of one hundred and fifty million organisms and the temperature had reached its maximum, a second dose was administered

with the idea of prolonging and intensifying the fever. The result was severe and probably dangerous, and proved of no great therapeutic advantage in the treatment of the disease. After the temperature subsided, several more doses were given, until the disease disappeared, when treatment was discontinued for a period of another month or six weeks. Then a third course of typhoid vaccinations were given beginning with only thirty million organisms. The highest temperature reached was 102.5 F., which was about the maximum temperature reached without the vaccine therapy, and the results were no more satisfactory than with the smaller doses.

After the first injection, the pain disappeared, but some jerking remained. After the second dose of thirty million organisms, the pain disappeared and the patient ceased to fear the return of the disease. This case is still under treatment. It is the belief that the condition can be controlled satisfactorily with small doses of typhoid vaccine.

It has not been possible to make any bacterial findings of a definite character, this being one of those cases in which the cure precedes the bacteriologic determinations. There is a possibility that a virus is present which is influenced by the increase in resistance resulting from the injections of typhoid vaccine. It is believed that the pain in the nerve tissue itself is caused by a distinct fluid circulating in and about the nerve tissue. In certain forms of nervous disease, the flow of the blood to the brain is controlled and corrected by the administration of typhoid vaccine in large doses.

This is a preliminary report and the results of further study will be reported later. It is my belief that the treatment for the relief of this disease is a success. The purpose of this preliminary report is to suggest to other men having experience with cases of tic douloureux the utilization of this method for the relief of their patients. This word of caution should be given: if no improvement is noted after the first four or five doses of vaccine, the operator should not become discouraged but should continue the use of the vaccine. Of course, it cannot be continued indefinitely, and one should not be discouraged if the symptoms return, but should administer the treatment again several times.

Eventually, immunity will overcome the disease and the patient will be spared the alternative of an operation—a very dangerous and disagreeable operation and one oftentimes associated with annoying, disagreeable and dangerous injury. This disease has afflicted the human family a long time and they not only have endured the distress of the pain itself, but also have submitted to surgical measures of different types, to injections and to medical treatment. They should not be asked to further endure the strain. It now appears that the disease can be cured by the method herein described.

OCCLUSAL RECONSTRUCTION

By H. D. Grubb, D.D.S., Cleveland, Ohio

IN occlusal reconstruction, the dentist meets one of the most complicated problems that come to his attention. This is nothing less than an effort to restore the original efficiency of masticating surfaces and, at the same time, establish a more normal relation of the structures which form the framework of the mouth.

The center of this problem is the patient who has reached or passed middle age. Often, a number of teeth are missing and those remaining are badly worn down and positioned, masticatory function, as a result, being seriously impaired. In addition, the health of the supporting structures may be involved as a result of unequal distribution of masticatory stress.

Because of the prior wear and tear that has taken place, the maxillomandibular opening has been decreased. This condition may be responsible for discomfort and disease, as well as being a challenge to beauty. The patient may complain of muscular fatigue and increased movement of the mandible during rest periods. There may be a disturbance of function of the temporomandibular joint. The decrease in length of the face may give a false appearance of age.

With these patients, we cannot afford to center the attention on the restoration of a single tooth or the filling of spaces: the problem must be considered in its entirety.

The advisability of a general reconstruction depends on the number and distribution of the remaining teeth, on the value of their supporting structures and, of course, on the patient's willingness to be guided by our recommendations. Restoring the maxillomandibular opening to normal is, therefore, of prime consideration in any plan that looks to a better functioning of the teeth, better health of the supporting structures and the comfort of the patient.

But hazards exist. One of these is the danger of establishing an opening too wide for the patient's individual muscular structure to accommodate. Mershon[1] has wisely pointed out the fact that the normal opening is a fixed relation, determined by the length of the muscles. When we tamper with the bony structures, we are of necessity also tampering with the ties that bind—the nerves and the muscles. Nature has built each one of us on a plan which in the beginning was harmonious. Moreover, muscular structure is dominant over bony structure just as function is everywhere dominant over structure in the organism. This muscular structure of the face cannot be stimulated to greater growth merely by mechanical pressure, particularly in the adult and settled body. Failure to take account of this vital fact may be the reason for some failures in occlusal reconstruction when an attempt has been made to provide so-called protrusive balance for all cases.

In restoring the normal relation, we reestablish the opening which existed before the loss or wearing down of the teeth, or a relation which is perfectly harmonious with the existing nerves and muscles. When facial muscles are in the

(Read before the American Academy of Restorative Dentistry, Atlantic City, N. J., July 10, 1937.)

normal and relaxed position, there should be a slight space between the opposing occlusal surfaces. If the opening as established is excessive and does not permit this relaxed position, discomfort is bound to follow, and the teeth supporting the opening will become still further embedded in the process. An excessive opening is also quite likely to cause interference with the formation of consonant sounds in speech.

Where the reconstructive program has been successfully carried out, the benefits are real and many. The additional space made available allows for longer, stronger and more retentive attachments on both fixed and removable bridges. It allows for the construction of new occlusal surfaces designed for efficient functioning and for a distribution of the masticatory loads in keeping with the demands of health. (Fig. 1.) In the occlusal portion, the additional space made available eliminates the danger of having to destroy tooth structure still further where much abrasion is already present. Altogether, this wider opening is a definite guarantee of better work, more accurate adjustments and sturdier and better looking mechanical substitutes for missing teeth.

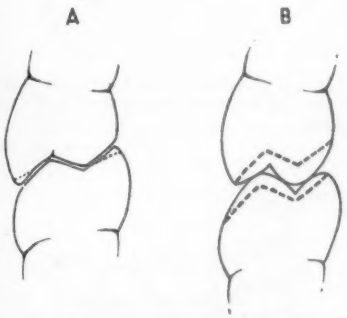

Fig. 1.—A, worn occlusal surfaces with broad contacts. B, normal occlusal contours restored.

In most cases, if there is sufficient impairment of function to require a general reconstruction, we are justified in including in this program the restoration of all the remaining bicuspids and molars. Then we can restore the occlusal surfaces to the efficient type found in the mouths of young people, before there is perceptible wear. (Fig. 2.)

These surfaces will give a point and line contact by means of sharp cusps, well-defined convex ridges and food-escape grooves that run buccally, lingually and to the embrasures.

Brodie[2] aptly describes the functioning of such surfaces thus:

> While their cusps make possible the efficiency of inclined plane mechanics, they do not meet as plane to plane but as convex ridge to convex ridge. These convexities lead to a functional stroke which in reality is a meeting of traveling points and thus we see that the first law of the shear is complied with. The ridges run in a number of direc-

Fig. 2.—Case in patient eighteen years of age, showing teeth without perceptible wear. These natural occlusal contours are more effective in mastication than are the broad occlusal contacts of worn teeth. Stresses on such convex surfaces are more limited and more favorably directed than at any time wear is perceptible.

tions, so that not one but a great number of shears may be brought into action. The function of any given shear is not so efficient as in a true flesh eater but the presence of such a large number makes possible a more generalized cutting of the mass and hence we have mastication instead of chopping.

Occlusal surfaces with all ridges convex not only are efficient masticating surfaces, but also tend to limit destructive lateral stresses; for, properly coordinated, these surfaces glide smoothly instead of locking in function.

Occlusal reconstruction solely by means of individual restorations in the mouth is not a practical procedure, because changes are often required in cusps and grooves as well as in the inclination of the teeth to assure their proper functioning in centric and eccentric positions of the mandible.

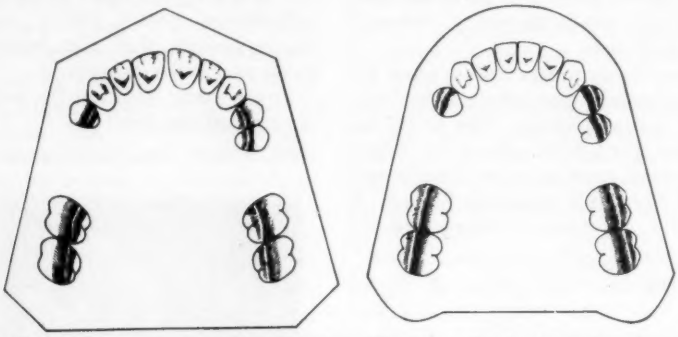

Fig. 3.—Case requiring a general reconstruction. There is occlusal wear and teeth are missing. Owing to the closed relationship, there is excessive stress on the anterior teeth, forcing the upper teeth labially and creating a space between central incisors.

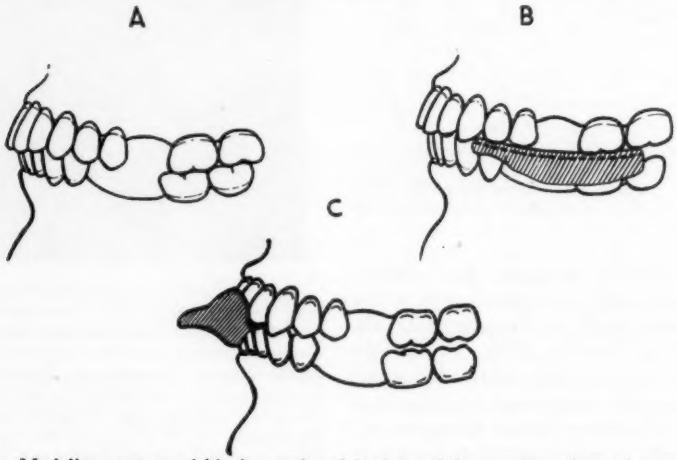

Fig. 4.—Modeling compound blocks employed in determining amount of opening to be maintained between reconstructed occlusal surfaces.

For an occlusal reconstruction of the highest type, occlusal surfaces must be both created and coordinated on an adjustable articulator upon which the centric, protrusive and right and left

lateral positions of the mandible can be registered accurately. It is understood that articulators do not necessarily reproduce the natural movements of the mandible, but it is safe to assume such a result, and practical results show that the occlusal surfaces can be depended on to guide this movement through the intermediate positions. The articulator that I employ in reconstruction incorporates incisal guidance on convex surfaces for both the protrusive and lateral movements. This guidance facilitates the creating of occlusal surfaces that are uniform in convexity and in inclination of guiding surfaces.

A discouraging feature of a general occlusal reconstruction is the difficulty of having the final results match the experimental or projected results as worked out on the machine. The finished restoration, in other words, does not assure such function in the patient's mouth as was obtained on the articulator. Many of us have found this out to our sorrow. In fact, it might be called the perennial tragedy of reconstruction. The sequence is as follows: After installation of the new work, extensive alterations of occlusal surfaces seem to be required before the patient can be made comfortable and unfavorable stresses eliminated. Repeated grinding of the new occlusal surfaces finally obliterates the carvings which at first offered such efficiency. These fine convex ridges with point and line contact are now changed to planes with a less efficient surface-to-surface contact. In the end, the patient is virtually back where he started. Before restoration, he had worn-out occlusal surfaces. Now, after restoration, supplemented by corrective

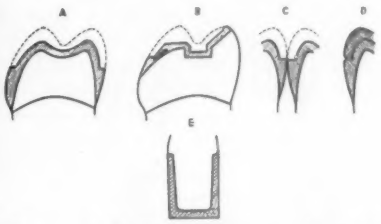

Fig. 5.—A, B, C, D, primary castings without cusps or other occlusal detail. E, low-fusing metal transfer crown for porcelain jacket preparations.

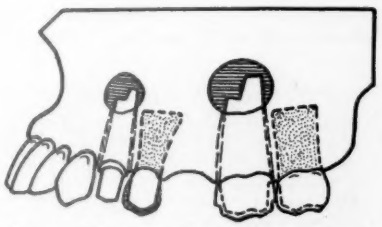

Fig. 7.—Master casts, with low-fusing metal supports for inlays and three-quarter crowns. The openings for die extensions are lined with copper.

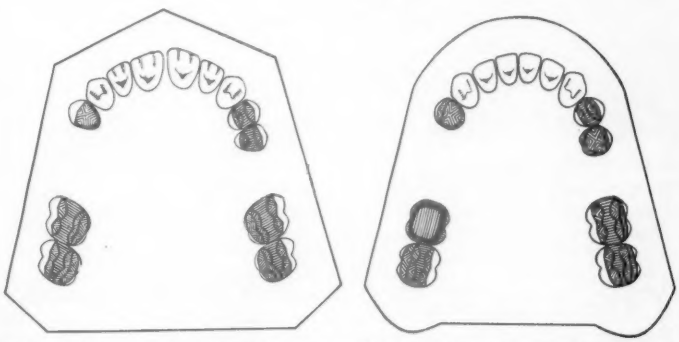

Fig. 6.—Primary castings in position on teeth before plaster impressions are made.

grinding, he is again reduced to worn-out occlusal surfaces.

These unsatisfactory results may be brought about by too much conjecture and too little real knowledge of the results accruing from the chosen technic. They may arise, for instance, from the method used for making the castings for the individual teeth, from the method of making registrations of mandibular positions or from the procedure followed in transferring these positions to the articulator.

It is of utmost importance that each completed restoration be seated on the prepared tooth in the mouth in the exact relative position which it occupied on the mounted casts. This accuracy can be secured only by making the casting for each prepared tooth without the cusps or other occlusal detail, and determining its proper adaptation to the walls and margins of the prepared tooth before all of these primary castings are transferred to the articulator on which the occlusal surfaces are to be completed.

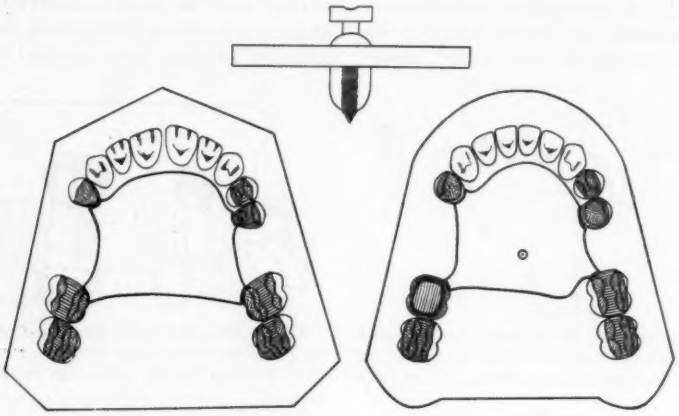

Fig. 8.—Relationship plates with center bearing screw.

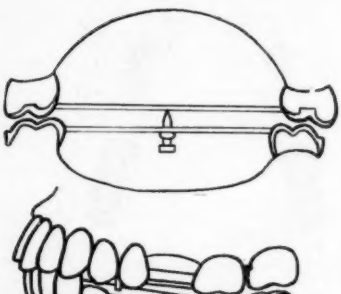

Fig. 9.—Lateral and lingual aspect of relationship plates.

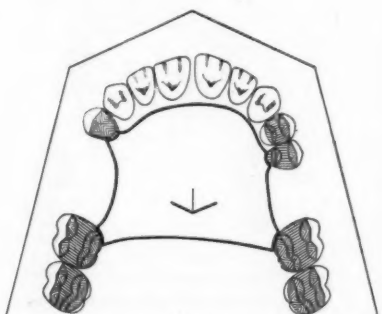

Fig. 10.—Upper relationship plate after tracings are made.

In the matter of castings, the superiority of hard gold alloys in assuring strength and validity to the castings is unquestioned. These gold alloys resist occlusal wear and their rigidity is sufficient to maintain the proper relationship to the walls of the prepared tooth. Adequate strength is thus secured without undue thickness in the casting.

Although the personal touch is undoubtedly a factor in securing the best results, it has been my experience that these hard alloys can be used to best advantage when the direct method of making wax patterns is employed. This holds good for all inlay and three-quarter crown castings. The hardness of these alloys obviates dependence on instrumentation to secure proper marginal adaptation.

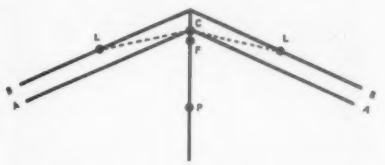

Fig. 11.—Gysi gothic arch tracings. AA, tracing made at centric level. BB, tracing made after screw is turned to provide for modifying influence of cusp height on position of mandible. The patient is also requested to swallow, then the plate is tapped lightly, the center bearing point being brought in contact with the upper plate. This tapping may mark the plate (F) slightly in advance of centric position (C) as indicated by the apex of the gothic arch tracing (AA). Failure of this mark to coincide with centric position (C) indicates that the patient has an acquired functional centric position to which the suspended mandible is habitually carried. Indentations which will engage the point of the center bearing screw in making plaster check-bites are made at C or F, LL and P. The dotted line, LCL or LFL, would represent a tracing incorporating the opening movement, if it were made after the restorations were installed in the mouth.

The transfer to the articulator in occlusal reconstruction is a procedure that requires a high degree of accuracy, since errors in transferring will result in interference of occlusal surfaces when the restorations are installed in the mouth.

Check-bites are used to register the maxillomandibular relationships in the centric, protrusive and right and left lateral positions of the mandible. Wax is not a reliable material for making check-bite registrations. It is a difficult matter to soften wax uniformly. It has a rebound owing to its elasticity. Its well-known tendency to shrink as it cools renders it doubly unreliable. The difficulty of correctly seating casts in either wax or modeling compound check-bites increases the

Fig. 12.—Mounted casts of practical case. A general reconstruction was indicated for the following reasons: Although an overbite was normal for the patient, there was a closed relationship, which was due to wear and faulty restorations. A satisfactory coordination of the occlusion could not be secured without excessive grinding of tooth structure. Four teeth besides the third molars were missing and two more were extracted because of periapical disease. The remaining teeth had vital, well-receded pulps and good supporting osseous structures. These teeth required extensive restorative measures, since nearly all surfaces of each tooth were involved.

possibilities of error in the transfer. In the technic which I employ, the various positions to be transferred are determined after making an intra-oral gothic arch

tracing at the vertical opening, which is to be maintained by the reconstructed occlusal surfaces.

The plaster check-bite as developed by Stansbery, Hight and others is used in making registrations of the exact functional positions that the mandible will occupy after restorations are completed. In this technic, provision is made for the modifying influence of cusp height. Stansbery[3] says:

> The plaster disks or registrations secured by this method contain the patient's individuality of movements. No external restriction or influence has been exerted, so that in these disks the confluence of the many and various elements contributing to the functional positions of the mandible are recorded.

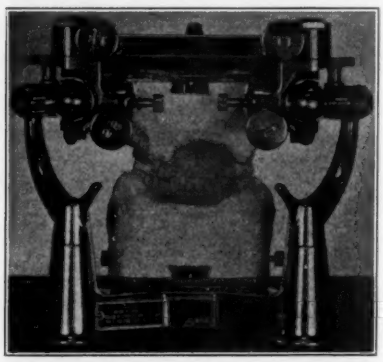

Fig. 13.—Lingual aspect of mounted casts shown in Figure 11. The relation of the lower incisal edges to the frenum is to be noted.

With the various positions accurately established on an adjustable articulator, we can dismiss from consideration many of the complicated problems of mandibular movement.

TECHNIC

Much of the reconstruction technic here described is but a grouping of ideas derived from many sources and it would be impossible to give due acknowledgment as to their origins. Although they may not represent the best combination for every one, they have served me well for several years and have resulted in a large measure of satisfaction. Careful attention to this technic or its equivalent will reduce to a minimum the necessity for adjustments after the restorations are installed in the mouth. The convexity of the occlusal ridges may be retained without destructive alterations.

In approaching the individual case, the following initial steps are taken:

1. Accurate casts are made and mounted in a way to allow for thorough and careful study of every detail of existing occlusion.

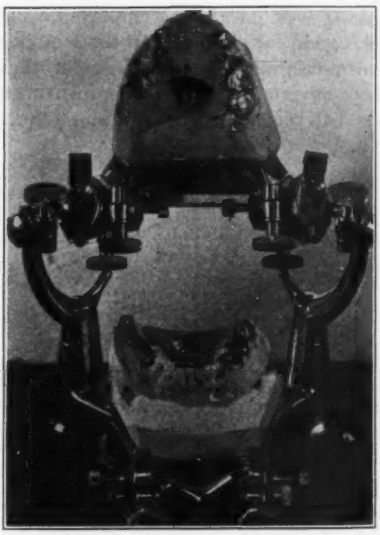

Fig. 14.—Relationship plates attached to primary castings in position on mounted master casts.

2. A complete roentgenographic examination is made.

3. Ample notes descriptive of the history of the case and of the conditions found in the mouth are taken.

Out of these fundamental data, we marshal our ideas for the attack and make our recommendations for restoration. Here, of necessity, each operator

must be his own judge as to how far dental retrogression must have gone to justify the extreme or generalized plan of reconstruction. And here, as in the actual work, I would urge the wisdom of conservatism. Do not recommend or work toward the extensive plan until you have thoroughly considered every possibility of arriving at health, comfort and correct function for the patient by correcting the existing occlusion and building to the present opening.

Two groups of cases may be noted: In one group, the existing occlusion is harmonious and efficient or can be made so without excessive destruction of tooth structure. In the other group (Fig. 3), harmony and restoration can be assured only by increasing the maxillomandibular

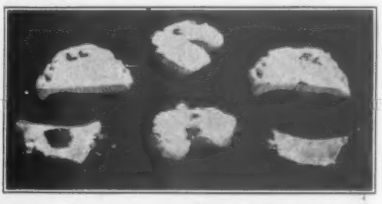

Fig. 15.—Plaster check-bites and relationship plates.

opening and inaugurating a general reconstructive program.

AMOUNT OF OPENING

Assuming that the case is one of the group requiring reconstruction, the first step is to determine what maxillomandibular opening is best to be maintained. Here, mechanical and esthetic features of the problem enter, but the governing factor is muscle length.

A safe limit of increased opening may be determined by forming modeling compound blocks on the lower cast. (Fig. 4.) These blocks are transferred to the mouth. Their height is adjusted until they just miss contact with the opposing teeth when the patient repeats "Mississippi" or "six sixty-six." Then, the blocks are reduced in height (1.5 mm.) to assure a slight space between the opposing occlusal surfaces when the muscles are in a relaxed position.

PREPARATIONS

Preparations are determined after a study of the roentgenograms and the mechanical requirements of the case. A general parallelism is required, especially for those teeth to which the metal relationship plates will be attached. Preparations should extend buccally and lingually

Fig. 16.—Completed restoration on master casts. The medium height cusps are to be noted.

to permit restoration of correct contour. Proper extension will facilitate the soldering of the added occlusal portion of the restoration, thus avoiding damage to the margins of the primary castings. A temporary inlay or crown conforming to the present occlusion is made for each prepared tooth. These castings are set with a zinc oxide-eugenol cement or with thick chloropercha.

PRIMARY CASTINGS

Castings without cusps or other occlusal detail, as suggested by Hollenback,[5] are made for each inlay and cast-crown preparation. (Fig. 5.) These primary castings will be part of the completed restoration.

The anatomic features will be added after transference to the articulator. Low-fusing metal transfer crowns are made for porcelain jacket dies. Correct adaptation of all castings is secured before making plaster impressions. (Fig. 6.)

With all primary castings in position in the mouth, a wax check-bite is made at the specific opening to be maintained.

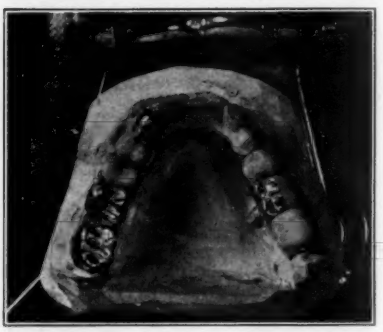

Fig. 17.—Close-up of restored lower cast. All occlusal ridges are convex. A precision attachment bridge restores missing teeth. The proximal contact plate of the lower right attachment carries a stressbreaker for the distal extension saddle. The full cast and porcelain crowns were indicated, as little sound enamel remained on these teeth. As mentioned before, the pulps were well receded.

Small tapered rectangular guide lugs are soldered to any castings which may not find a definite seat in the impression.

MASTER CASTS

Master casts are made of the plaster impressions. (Fig. 7.) Each inlay and three-quarter crown is then blocked off with moldine and a low-fusing metal support is poured. To provide accurate replacements of dies on the casts, 40-gage annealed sheet copper is swaged (not burnished) to contact all surfaces of the tapered low-fusing metal root extensions of the dies. Before swaging, ridges are formed in the copper sheets by folding. The smooth side of the copper adjoins the root extension. The cast material will engage the ridges and assure stability. With the dies in position in the primary cast crowns and in the transfer crowns, the cast is completed with artificial stone. The guide lugs are removed, the wax check-bite is placed in position and the casts are mounted on an articulator for proper positioning of the relationship plates.

Fig. 18.—Close-up of a restored upper cast.

RELATIONSHIP PLATES

Wax patterns for the relationship plates (Fig. 8) are made to contact the supporting primary castings. German silver or coin silver 14-gage is cut with a saw to the dimensions of the wax patterns. A center bearing screw, having millimeter threads and a guard to prevent plaster from engaging the screw, is attached to the lower plate. The plates should be parallel at the opening determined for the case. (Fig. 9.)

There should be a space of 3 or 4 mm. between the plates to permit making plaster check-bites. In many cases, the necessary space can be obtained only if

the primary castings to which the plates are to be soldered extend well over onto the lingual surfaces. The plates are attached to three castings by soldering and should rest on another casting. Attaching these relationship plates to the primary castings by soldering is an important feature of this technic. This firm attachment insures the accurate positioning of the plates in the mouth as well as on the casts. If this accuracy is not obtained or if the plates are not stable in position, conjecture enters the technic.

The upper plate is heated and waxed articulating paper is drawn over the tracing area. With the plates in correct position in the mouth, an intra-oral gothic

Fig. 19.—Small vent made in full cast crowns, permitting excess cement to escape and making possible accurate seating of crowns. As suggested by Cooley, the opening may be inlaid with round wire. A bur of correct size may be selected after holes are drilled in a toothbrush handle.

arch tracing is made at the determined centric level. To provide for the modifying influence of cusp height on the functional positions of the mandible, the lower plate is removed and the screw is turned to increase the opening 1 mm. or 1.5 mm., the amount depending on the height of cusps to be employed for the case. (Fig. 10.)

With the plate again in position, another tracing is made. This tracing will be posterior to the tracing made at centric level. With the smallest round bur, a slight indentation is made for centric position on the anterior tracing, for the lateral positions on the posterior tracing and for protrusive position. (Fig. 11.) The lateral and protrusive positions for transfer are about one-eighth inch from the centric position, the distance depending on the measurements of the posterior teeth and the overjet of the anterior teeth.

PLASTER CHECK-BITES

Plaster check-bites are made by injecting a quick-setting mix of plaster into the space between the plates. Stansbery's plaster syringe or Terrell's cellophane

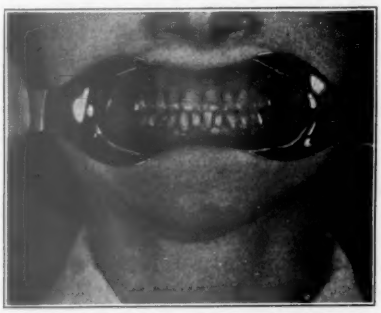

Fig. 20.—Restoration of mouth, centric position. The porcelain jackets on the upper central and lateral incisors were made after the other restorations had been installed. These restorations were completed eighteen months ago. The teeth function as they were planned to function on the articulator, with one exception: the buccal cusp on the upper right second bicuspid required a slight corrective grinding. The patient has been comfortable from the beginning, there being no soreness nor increased mobility of the teeth. There has been a definite improvement in the health of the soft tissues about the teeth.

cones are used for this purpose. With the center bearing point engaged in the indentations, a plaster check-bite is made for each position. The right and left lateral and the protrusive check-bites are

made first. Then the screw is turned back to centric level for the centric check-bite. The plates and centric check-bite should be removed without separating. This insures accurate centric mounting on the articulator.

A face-bow and Wadsworth "T" registration is made for positioning the casts on the articulator.

The casts are then mounted on a fully adjustable articulator. The articulator is adjusted to the functional positions of the mandible as recorded in the plaster check-bites. The calibrations of the instrument are recorded on a suitable chart. The plates are detached from the primary castings.

COORDINATING THE OCCLUSION

The interrelation of the factors entering into a satisfactory coordination of the occlusion may be studied in an excellent article by Stallard[4] on "Dental Articulation."

All of the prostheses are formed in inlay wax, cuspal coordination being secured well in this plastic material.

A small amount of fluxed wax is placed on the primary castings before the inlay wax is added. After the wax carving is completed, a shallow groove is made with a fine instrument on the line where the inlay wax joins the primary casting. After casting, a small amount of solder in this groove insures the union of the castings. (Fig. 5 D.)

The next step is to complete all of the individual castings and unite them with solder. Where opposing spaces are to be supplied with bridgework or where there will be opposing porcelain jackets, the wax patterns for these restorations are cast in technic metal in order to provide a hard surface against which the opposing porcelain can be accurately adjusted.

After completion of all restorations, the milling device on the articulator is set ten thousandths inch off center and the case is milled, meanwhile being carefully controlled by the incisal guidance post. This provides the freedom in the occlusion which is most essential to a satisfactory result and which is found in a good natural dentition. Then the supplementary grooves are carved with small burs and knife-edge stones. Thus the shearing mechanism of the occlusal surfaces is perfected.

The installation of the restorations in the mouth calls for extreme care and attention to detail. It is here more than at any other point that the dentist may meet his Waterloo; or, if he has worked wisely and well, he may meet his greatest reward. He will see what promises to be a satisfactory reconstruction of a badly impaired mouth with restorations that look and function like the natural teeth.

CONCLUSION

I should like to emphasize what has been the real theme of this paper: the necessity of proceeding in each step of the chosen technic with caution and extreme attention to detail. Only by observing the utmost care in making measurements, casts and mountings can there be any hope of success in the outcome of this work.

Here, I think, is the answer to many justifiable complaints that cusps cannot be made to "work" in the mouth of a middle-aged person or in a mouth reduced to broad occlusal contacts. Undoubtedly, the creation of new technical ideas has opened up a wider approach to this problem, and has made it possible to conceive of the possibility of reestablishing the original contours and function of the mouth.

Today, with the more refined technic at hand, we can afford to be both bolder and more confident. But, as in all scientific advancement, the coming of the new technic has brought its own increased responsibility; for it embodies powers for destruction equal to its powers of construction. The highly complex instruments of war can establish a wider

defense, but they can also produce far greater havoc. So, in accepting new technic and higher ideals, we do so only at the expense of greater vision and vigilance.

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HOW TO EDUCATE THE FAMILY DENTIST IN PERIODONTIA

By Benjamin Tishler, D.M.D., Boston, Mass.

HOW to educate the family dentist in periodontia is considered by those most familiar with the subject the outstanding unsolved problem of dental practice. The reason for this belief is that much attention has been given to caries for many years by practitioners and comparatively little to the diseases of the periodontal tissues. Should half the study now given to the former be devoted to the latter, the number of periodontoclasia cases, which are so prevalent, would be greatly decreased. Unfortunately, pain, a symptom of caries, is not commonly associated with periodontoclasia; which accounts in part for this state of affairs, because, if pain were present, patients would insist on treatment. However, if neglect meant the loss of the teeth only, it would be sufficiently serious; but when it is definitely known that other parts of the body are affected, the lack of attention given the periodontium is clearly an avoidance of a professional duty. Lung abscesses, affections of the joints and numbness of the hands are but three of many afflictions directly due to the toxins which are aspirated or absorbed by patients affected by periodontal disease.

To those of us who for many years have been endeavoring by written articles, talks and clinics to interest the family dentist in periodontia, the results have not been flattering, to say the least, since the disease is still found in the mouths of many patients, a considerable number of whom are under 20 years of age. The Editor of The Journal wrote three editorials at different times, within three years, relating to the problem because he is familiar with the prevailing neglect. His language was emphatic and his purpose good, but, unfortunately, editorials of this kind are read, as a rule, by those most interested in periodontia; in other words, many practitioners to whom the information would be useful, rarely, if ever, read anything pertaining to the subject. The profession, as a whole, simply has not grasped the importance of this dental problem and apparently will not recognize it until forced to do so.

(Read before the Section on Periodontia at the Seventy-Ninth Annual Session of the American Dental Association, Atlantic City, N. J., July 14, 1937.)

Unfortunately, some colleges are as much at fault as individual practitioners.

It is no credit to the dental profession that the principles of periodontology are practised by a limited number of family dentists. Those that disregard these principles consider that dentistry is a reparative calling, which it unquestionably is in a large degree. However, it is not wholly so, and therefore dentists should be familiar with the principles which govern periodontia that they may practise their profession as it should be practised, these principles being the foundation of every dental operation, with the exception of exodontia and oral surgery. They have much in common with medical practice, because, among other things, it is necessary to understand the phenomena which control the reaction of cells to injury and to subsequent treatment.

The best way to educate the family dentist in periodontia is to furnish him with simple, direct information which will arouse his interest (assuming that he has little or none), or, if he is already interested, broaden his knowledge in this way. His education differs from that of a student in that he studied periodontology when in college and has, as a rule, some ideas regarding it, but many dentists cease to be students after they receive their degree and fail to realize that much progress has been and is being made in this branch of dentistry. The problem may be discussed in two ways: by treating it from a theoretical standpoint, offering advice only, which incidentally most practitioners dislike; or by combining theories with instances of errors in practice, a knowledge of which will be useful to them. The latter course will be followed in this presentation.

In order to create or promote an interest in periodontia in the family dentist, one should first convince him that treatment is not difficult, that periodontoclasia is amenable to it and, what is equally important, that he should inform his patients of the latter fact. One of the most discouraging things that confronts a periodontist is that, not infrequently, friends of patients whom he is treating tell them that they are wasting time and money because dentists from whom these friends receive dental services tell them that it is useless to treat periodontal conditions. On the other hand, some family dentists admit that periodontists can improve conditions by treatment, but consider the improvement to be temporary. As a consequence, they believe that the progress of the disease cannot be checked permanently after its inception and many make no effort to treat it. An expression not infrequently heard is "The forceps are the only cure for pyorrhea." This misconception of the practitioner is due to the fact that he has been unsuccessful in treating cases. Unfortunately, he is not aware of the faults which are responsible for his failures, but what is more unfortunate, he makes no effort to learn what they are. Any attempt to treat periodontoclasia with such a preconceived belief is doomed to failure.

In my college course, thirty-five years ago, we were taught that disease of the periodontal tissues was incurable and, as a consequence, I believed this for some time. In the meantime, I used medicaments, emetin and vaccine injections, in an endeavor to stop the pus discharge, without satisfactory results. However, at one of the national meetings, about twenty years ago, I learned of the successful results that members of the American Academy of Periodontology were reporting and it occurred to me that I could be equally successful if I learned what their method was. From this personal experience, I am convinced that confidence in one's ability to conquer disease factors is important. This cannot be emphasized too strongly. Incidentally, it may be mentioned that the annual meeting of the American Academy of Periodontology at which these matters are discussed and clinics

given is open to all members of the profession.

The second point to be considered is that the family dentist should have a better knowledge of the disease than he has at the present time. The pathologic changes which take place in the cells of the periodontal tissues must be understood for success in treatment. This knowledge can be acquired by studying any book on general pathology, because cell changes due to injury are the same all over the body. The family dentist should also read current articles on periodontia pertaining to clinical and research matters, which appear regularly in our journals, and attend periodontal clinics whenever he can. The family dentists with whom I have come in contact are unfamiliar with the foregoing matters, particularly the research. They are more interested in the advertisements of proprietary preparations usually found in commercial journals, which are sent to them without cost. These drugs or pastes, the formulae of which are never made public by the manufacturers, are sold with a promise of positive results, and it is surprising to observe the number which appear continually on the market and which are proved worthless later when submitted to analysis by the Council on Dental Therapeutics of the American Dental Association.

The continual appearance of these so-called pyorrhea remedies is the result of the family dentist's desire for a short cut in treatment. This indicates a lack of knowledge as such a thing is an impossibility. A short cut in treatment has never been found, and it is surprising that the family dentist will try preparation after preparation or purchase some piece of apparatus on the recommendation of a convincing salesman in a sort of will o' the wisp chase to achieve the impossible. Periodontists never depend on any preparation in their practice. In fact, medicaments have no place in treatment (in my practice and many others) except, of course, in Vincent's infection. A point which cannot be brought out too strongly in this paper is this: There has been no medicament of any kind yet offered to the profession, regardless of the claims made for it by the manufacturers, that is useful in the treatment of periodontal disease. Those that have been offered usually contain an astringent which will improve gingival tone, and this deceives the practitioner, who gains the impression that a general improvement has resulted in all the diseased tissues. Poor gingival tone, it must be remembered, is the result and not the cause of the pathologic disturbance; and therefore any improvement in the tone of this tissue alone will not check the progress of the disease.

The family dentist should be impressed with the necessity of treating cases early. This, without question, is the most important point in this paper, because, as has already been intimated, his greatest weakness is that the disease is allowed to progress too far before he recognizes it. We will grant that he has become familiar with the biologic principles of periodontology and has mastered the use of instruments and the correction of an occlusal traumatism and is thus fully qualified to treat periodontal disease. His paramount duty, then, is to prevent the development of incipient lesions to the best of his ability. He has an unusual opportunity to do so because of his contact with many young patients. Much emphasis is placed on this preventive measure because no statement has been offered yet by research workers or clinicians which will explain why periodontal pathosis will develop in one mouth and not another, when apparently similar conditions exist in the two, although some progress is being made in this field.

Consequently the disease must be controlled by resorting to early treatment measures, as we know them; i.e., until the etiology has been firmly established.

It is not strictly correct to state that suppurative periodontoclasia can be cured, but rather it should be said that it can be held in check indefinitely by proper local treatment. It will always recur, however, if the patient neglects to stimulate the gingival tissues; which would seem to indicate that some patients are predisposed to the development of the disease under certain conditions. Periodontal disease is only amenable to treatment when sufficient bony supporting structure remains intact. This again emphasizes the necessity for early treatment, because it is not difficult for the family dentist to check the disease at this stage. The problem becomes increasingly difficult as the destruction becomes more marked. It has been my experience that many family dentists attempt to treat advanced cases without sufficient ability to do so.

It seems almost unnecessary to state that early symptoms must be recognized before they can be treated. Most family dentists are weak in their ability to detect early symptoms. It is believed at present that most cases of periodontoclasia are due to local conditions, because the results of eliminating irritants are good. There are constitutional factors in some cases, with local ones superimposed upon them, but the greatest number of cases are believed to be caused by local irritants alone. As a consequence, the family dentist should, in these instances, be able to recognize at once the various abnormal gingival changes. These are always found in the interdental papillae, a portion of the gingiva on which he should focus his attention. The diagnostic importance of the interproximal portion of the gingiva in cases of early periodontoclasia, due to local conditions, is not appreciated, nor has it been sufficiently emphasized, because the inception of the disease takes place in this area usually, the labial or lingual portion of the gingival margin being affected later, if the early lesions are not checked. Every color change, whether to deep red or bluish or pale gray, should have an immediate significance in the eyes of the observer. The same is true of contour changes. Any variation from the flat, pointed triangle of gum tissue, whether it is much swollen with a markedly rounded tip or slightly swollen, with or without a horizontal line at the base of the swelling or with a vertical or several irregular lines in it, is an indication of a pathologic process beneath the gingival surface. Mention should be made of Stillman's clefts, which develop in the marginal gingiva and always denote the presence of an underlying pocket, usually a well-developed one, with granular deposits on the root surface. Family dentists, as a rule, are not aware that deep pockets may be present, without any external change whatever in the gingival tissue, which may be pink, with tissue firm and no apparent change in contour. These characteristics, which are found in the vertical type of disease, are very deceptive to those who make a superficial examination in periodontal conditions. Suppuration is infrequently a symptom. It is found much more often in the type of disease due to local conditions. This would seem to indicate that the gingival tissue of these patients is less resistant to the attack of suppurative bacteria than the other type.

As may be gathered from these statements, there is a wide variation in cell response to injury; therefore, the family dentist should carefully examine the gingivae several times a year. This applies to patients of all ages because there is no relationship between age and the inception of the disease. Frequently, it develops in the mouths of patients under 20 years of age, and it should not be taken for granted that because it is not present during an examination it will not be found later. Patients believe, and rightly so, that the family dentist is as responsible for the health of the supporting structures of the teeth as he is for the

teeth themselves. If a person builds a house, he expects that the foundation will support it, because, no matter how well it may be furnished, it is useless if the foundation is poor. Excellent fillings put in teeth which are extracted later because of the ravages of periodontal disease mean just so much time, effort and expense wasted.

The family dentist should examine the gingival crevice with a smooth narrow, thin instrument, which can be made by him from an old hoe type scaler. If the gingiva bleeds when touched, poor cell tone is indicated; and if the instrument reaches a depth of 3 mm., it is safe to conclude that periodontoclasia is present. Roentgenograms should be taken to ascertain the extent of the alveolar destruction. However, they do not always indicate this accurately, it being found frequently that a curetting instrument will reach a deeper area than is shown in the film. This discrepancy is more common in the type of disease caused by constitutional than in that caused by local conditions. Nevertheless, roentgenograms are a valuable aid in treatment because poorly filled root canals or an unsuspected periapical area of infection, overhanging edges of fillings, poorly fitting gold bands or crowns, etc., are readily seen. They are very useful in assisting the examiner to diagnose early cases of the vertical type of periodontoclasia, which can be detected in no other way because the gingivae become affected only after the disease has made some progress. A resorption of the lamina dura or a radiolucency of the interdental alveolar process always precedes this complication.

The methods most commonly employed by operators to remove diseased tissue and root deposits are classified as conservative and radical. The flap operation may be considered as intermediate. Some use one method in all cases; others use the one that the case seems to indicate. It is my opinion that the family dentist can obtain the most satisfactory results by using the conservative method because it is not difficult to master. His principal faults when he uses it are a lack of patience, poor technic, the use of unhandy or dull instruments, failure to relieve occlusal traumatism and a lack of appreciation of the importance of the patient's cooperation. No controversy on the merits of any method is intended in this paper. Each successful operator, as is natural, considers his method superior to all others; but I have yet to be convinced of the superiority of any of the radical methods over the conservative, as a routine procedure. The conservative method has been and is still being used by more practitioners than any other since Riggs demonstrated its value in 1867. When properly employed, it will give consistently good results. The removal of calcareous deposits, granulomatous tissue and cementum cuticle is but one step in the successful treatment of periodontal pathosis, but it is not the only important one. Some emphasize it to such an extent that one gathers from written articles describing various radical methods that it is all important. Those who depend only on subgingival curettage or any radical method alone will not have successful results no matter how well the operation may be performed.

The family dentist needs much more knowledge regarding the relief of an occlusal traumatism than is now the case, because, as a rule, he does not understand this as he should. The grinding is overdone, underdone or not done at all. I have seen cases in which it has been carried to such an extent that cusps have been entirely ground away and molars and bicuspids left with flat occlusal surfaces. One of the many difficulties of the family dentist is to know where, and how much tooth substance, to grind. Another is inability to diagnose and relieve a so-called locked occlusion, which is caused by the presence of deep interlocking cusps which prevent lateral movements of the mandible when it and the maxillae

are in centric occlusion. This condition often results in mobility of the teeth. Plaster models should be used in all cases that require occlusal grinding, which should be done slowly and carefully with stones that are not too coarse.

The next subject to be discussed relates to the everyday tasks of the family dentist, namely, operative and prosthetic restorations. This has been touched on so many times that it seems almost unnecessary to allude to it again. Neverthless, it is still one of the weaknesses of dental practice. If conditions were reversed and the family dentist could see the amount of faulty restorative work that the periodontist sees, when patients are referred for treatment, he would be amazed. It is no exaggeration to say that faulty operative and prosthetic restorations are responsible for the inception of almost half of the cases of the local type of periodontoclasia. Excess of filling material at the cervical margin, whether from a mass of amalgam or an overlapping gold inlay, is the most common fault. In both instances, it is due to incorrect technic; the first unconscious, the second conscious, since the operator feels that overlapping the margin will prevent a recurrence of caries. These conditions are bad from a periodontal standpoint because they cause gingival irritation. The presence of badly carved fillings with a defective marginal ridge results in food impaction and a periodontal pocket. A lack of proximal contact points has the same effect. Poorly adapted crowns (jackets or any other variety), deep metal bands which impinge on the gingival group of fibers, whether used in orthodontia or in prosthodontia, clasps which are made without occlusal rests and others which are so fitted that they lie against the gingiva and push it back when the patient masticates his food are responsible for gingival inflammation, as is the saddle of the plate of which they are a part. These are some of the many irritants responsible for the development of periodontoclasia.

Another etiologic factor in periodontoclasia is the cast metal partial plate. This denture can be worn in safety in many instances. It should not be made for a patient who has lost teeth from periodontoclasia until one is certain that bone regeneration has resulted after treatment and the tooth consequently has become stabilized, because the denture is usually forced into position and will eventually loosen the teeth around which the clasps are fitted, much as an orthodontia appliance would. The teeth of patients who have had periodontoclasia at any time are poor risks when any appliance is to be held in position with cast clasps. Many practitioners make the mistake of failing to supply artificial teeth (by either a bridge or a partial denture) for patients who have lost one or more bicuspid or molar teeth. Sometimes, this condition is permitted to exist for years. It is not an uncommon occurrence and is either an indication of the practitioner's carelessness or a misunderstanding of what such neglect will do. The patient in whose mouth this is seen is compelled to masticate his food with the remaining teeth, which, as a consequence, are subjected to overfunction, while the other teeth, which formerly occluded with those that were extracted, are not used and frequently become diseased and elongate. Pathologic lesions result as early from overfunction as from nonfunction. Moreover, teeth on either side of the space, which may still occlude with those of the other jaw, may drift, turn or tip forward, and an occlusal traumatism results which often causes mobility of all the teeth concerned. Substitutes for missing teeth should always be made as soon as healing of the tissues will permit. Sometimes, it is necessary to insert space retainers temporarily to prevent movement until this can be done.

The periodontist often sees cases with no bicuspid and molar occlusal contact because of neglect by the family dentist. There is a heavy occlusal impact on the

incisors and a change in the position of the head of the mandible, which often results in impaired hearing. The heavy occlusal stress on the incisors pushes them out of their natural position so that they separate and become very loose. Extraction is the only recourse, eventually, unless the bite can be opened with partial dentures before too much alveolar support has been lost. In some cases, where a single tooth has been extracted, the drifting may not be marked, but sufficient to permit food to crowd into the space or spaces during mastication. Food impaction results and this, in addition to the occlusal trauma, will cause as severe an injury as poor cervical margins of fillings. The space should always be closed with a proximal filling. It is good dental technic, from a periodontal standpoint, to cut into sound tooth tissue and insert a well-contoured inlay to close the space. It has been my experience that the family dentist hesitates to do this, but it is far better to cut away good tooth substance than to allow food impaction to cause periodontal pockets, with ultimate loss of both teeth. The necessity for more careful restorative work cannot be stressed too strongly. Carelessness or indifference should never enter into professional relations with patients, because it is unfair, almost dishonest, to create or allow to exist without correction a condition which will result eventually in disease and loss of teeth because of faults for which we are directly responsible.

A valuable point in the education of the family dentist is emphasis on the importance of convincing the patient of the necessity for cooperation during and after treatment. In my opinion, the points that should be most stressed in the treatment of periodontal disease are diagnosis, treatment of early symptoms and the patient's cooperation. A knowledge of the use of the toothbrush to stimulate gingival tissue by massage and its help in maintaining cell health is not sufficiently appreciated by practitioners, although it has been advocated by periodontists for many years. That many family dentists do not know how to massage the gingivae is indicated by the fact that they frequently advise patients to use a rubber brush on the cemental and alveolar portions or massage them with the ball of the forefinger. Neither is of any benefit from a periodontal standpoint and they invariably result in failure of treatment. It should be remembered that if suppuration has been checked and the pocket reduced or eliminated, regardless of the method used, the permanency of treatment depends entirely on the care given by the patient afterwards, because the micro-organisms that were responsible for pocket formation and suppuration are still present in the oral flora and will reinfect the gingival cells unless cell resistance is kept high by gingival stimulation.

Many family dentists advise patients to brush the gingivae and advocate the use of a paste, powder or mouth wash; but advice is not sufficient. Patients should be given one or more demonstrations, as may be needed, and must in turn repeat the procedure until the practitioner is satisfied that they do it well. It is essential that the family dentist be familiar with it, because obviously it cannot be demonstrated properly unless he is. The interproximal portion of the gum, as has already been pointed out, is the most important portion from a periodontal standpoint, and it is impossible to stimulate it when the teeth are brushed with a sweeping motion from the cervical margin to the occlusal surface or when the ball of the forefinger is used. Those practitioners who understand the result of proper gingival massage realize this. Charters demonstrated a method of gingival stimulation at least eighteen years ago, but the profession was not particularly interested in it at that time and only a limited number were impressed with it. His method, however, has proved its worth and is used by periodontists all over the country, some with minor changes.

Stimulation of the gingiva will result only when the side of stiff toothbrush bristles are pressed firmly against it and the capillary blood is forced out of the vessels. This will cause the tissue to blanch and, when the pressure is released, fresh blood will rush into the capillaries and force the hitherto stagnant blood ahead of it. A restricted side to side or rotary motion is used. I prefer the latter. This method practised two or three times a day will not only result in a better gingival tone but will brighten the teeth as well. The use of a powder or paste is unnecessary, although the manufacturers of these preparations would have us believe that it is. A brush wet with a normal saline solution is all that is needed.

It might be interesting to explain why teeth become brighter without the aid of powder or paste, an explanation that has not been sufficiently stressed. There is a circulation of blood from the gingivae to the pericementum, into the pulp, and another from the periosteal vessels, into the pulp. This tissue, therefore, receives blood from two sources. When the gingival capillaries are stimulated, a better tone results because the pulp receives an abundant supply of fresh blood, which was lacking previously. This constant nourishment brightens the teeth and they become glossy and brighter regardless of what is put on the bristles. A dry brush properly used would accomplish the same result. This condition is duplicated in the appearance of women's hair. Glossiness of the hair is the result of constant brushing with a dry brush which stimulates the blood supply of the fair follicle. Many family dentists doubt the truth of the statement that it is possible to brighten teeth without the aid of powder or paste, but they may be assured that if they will carry out for two weeks the procedure heretofore explained, they will learn their error. I have used it for almost twenty years with much satisfaction. Aside from its importance as an adjunct in treatment, the value of the toothbrush as a preventive agent has not been sufficiently emphasized. If the family dentist would teach his young patients how to use it properly, as has been described, and follow his instructions with regular prophylactic treatments, the combined measures would be invaluable in keeping the gingival tissues healthy and would prevent large numbers of marginal atrophy cases.

This covers the subject under consideration, but only briefly, for much more could be said without exhausting the possibilities.

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LOCAL ANESTHETICS AND VASOCONSTRICTORS AS THEY PERTAIN TO DENTISTRY

By Howard C. Miller, D.D.S., F.A.C.D., Chicago, Ill.

DURING recent years, much research and experimental work have been done in an effort to produce a perfect local anesthetic solution, and whatever future advancement there may be in the use of local anesthetics will undoubtedly be toward the perfection of the solutions that are to be injected.

In view of the fact that our technical procedures are based entirely upon anatomic relations in the human skull, it is obvious that there cannot be much variation in the manner of injection. Occasionally, refinements in technic are offered by attempts to simplify the methods of injection, but in most instances these are based upon the procedures followed by those who first presented the technic for blocking various branches of the fifth cranial nerve.

In the past, attention has been called to the importance of using a solution which is isotonic, and the necessity for using calcium, sodium and potassium chlorides, such as are contained in a prepared Ringer's solution, for the anesthetic vehicle. Only during the past few years has the importance of the hydrogen-ion concentration of the solution to be injected been emphasized.

Clinical investigation has not substantiated all the claims of the advocates of alkaline solutions, it appearing that the pH of any injected solution will be rather rapidly adjusted to normalcy by the buffer action of the body tissues and fluids. The pH of tissues locally is by no means so easily disturbed as we have been led to believe, although ample experimental data, obtained under conditions more adaptable to accurate objective evaluations than are possible under clinical test conditions, indicate that the development of anesthesia is more rapid and the duration of complete anesthesia increases significantly as the pH of the local anesthetic solution increases to a maximum of pH 8.4 to 9.0.[1, 2, 3, 4, 5]

From a theoretical as well as from a practical or experimental standpoint, the efficiency of the salts of local anesthetics, alkaloids, etc., is enhanced when the compounds are present as the base. When a solution containing a local anesthetic agent and a vasoconstrictor is combined with an alkali, the alkaloid or base is more readily liberated; which facilitates the absorption and penetration of the active principle. However, the change in the character of the anesthetic solution under these conditions is important from another standpoint, as such a solution is less stable, saponification of the anesthetic to an inert compound (p-amino benzoic acid) tends to occur and the degree of change increases markedly with time. The degree of deterioration is governed primarily by the degree of alkalinity present as well as by the age of the solution. Such changes do not increase the toxicity, but do render the anesthetic compound more inert.

Tainter *et al.*,[6] in their clinical comparison of a 2 per cent solution of procaine hydrochloride and a 4 per cent

(Read before the Section on Oral Surgery, Exodontia and Anesthesia at the Seventy-Ninth Annual Session of the American Dental Association, Atlantic City, N. J., July 14, 1937.)

TABLE 1.—SURVEY OF LOCAL ANESTHETICS*

Compounds Hydrochloric Acid Salts	Anesthetic Efficiency: Rabbit Cornea (Mucous Membrane) Ratio to Cocaine = 1.	Anesthetic Efficiency: Rabbit Cornea (Mucous Membrane) Duration Minutes	Local Irritation Greatest (1) to Least	Intraspinal Effects: Rabbits† Minimal Concentration for Sensory Anesthetic	Intraspinal Effects: Rabbits† M.L.D.‡	Therapeutic Ratio#	M.L.D. Mg. per Kg. Subcutaneously Guinea-Pigs	M.L.D. Mg. per Kg. Intravenously Rats	Estimated Safe Dose for Man Mg. (Subcutaneously)
I	II	III	IV	V	VI	VII	VIII	IX	X
				Per Cent	Per Cent				
Procaine	0.06	5	6	0.9	6.0	6.6	350–600	55	430
Tutocaine	1 to 2	25	3	0.5	6.0	12.0	116–271	—	193
Panthesine	0.5	—	5	0.5	4.0	8.0	75–150	—	112
Metycaine	1.0	60	4	0.86	3.5	4.0	—	—	100
Alypin	0.5	—	-	—	—	—	60–100	15	72
Butyn	2.0	30	3	—	—	—	70	12.5	70
Phenacaine (Holocaine)	2.0	20	2	—	—	—	50–60	—	53
Cocaine	1.0	30	-	—	—	—	20–80	15	50
Pontocaine	30.0	85–120	2	0.05	1.5	30.0	—	7.5	20
Nupercaine	30.0	45–90	1	0.07	0.8	11.4	7.5–15	2–5	11

*Data adopted from publications by R. N. Bieter *et al.*, 1936; Hirschfelder & Bieter, 1932.
†Equal volumes were injected in all experiments.
‡Minimum lethal dose.
#$\frac{\text{Data column VI}}{\text{Data column V}}$ = Column VII.

solution of procaine borate (which contains 51.8 per cent of procaine base) as local anesthetics, concluded that on the basis of procaine *per se,* no differences between the two compounds were demonstrable as to the volume of solution required or the period of time required for the induction of anesthesia or its duration. Likewise, certain side effects, i.e., changes in blood pressure, pulse and respiratory rates, from the two solutions were practically identical, both causing small average increases in pulse, respiration and systolic blood pressure; but the incidence of perspiration, nervousness, tremors and fainting was almost twice as frequent with the borate as with procaine hydrochloride. The concentration of epinephrine used (1:50,000) was the same in the two solutions injected.

Their findings compare favorably with the electrocardiographic study reported by Miller, Stuart and Dick,[7] in which injections were made with procaine borate combined with epinephrine in a comparative study of the individual patient's reaction to various local anesthetic solutions. During this investigation, electrocardiograms were made before and after the injection of the solution, and in the five cases in which procaine borate with epinephrine was injected, the average increase in the heart rate was eleven beats per minute and the rhythm was not altered, but there were definite T-wave changes in all five cases. Our experiences indicate that the use of procaine borate and procaine hydrochloride in equal concentrations has similar local effects, which, in the volumes used, were indistinguishable. This practical experience, when considered in conjunction with that of Tainter and his co-workers, seems to indicate that the facts regarding acid and alkaline solutions are quite incomplete, in that, in our experience, little variation in the promptness and intensity of anesthesia, postoperative discomfort or other complications can be traced to the procaine solutions used, regardless of whether they are on the acid or the alkaline side.

Since 1884, when Köller first described the local anesthetic effect of cocaine, the history of local anesthesia has been marked by an effort to eliminate all objectionable effects. In 1901, advantage was taken of the vasoconstricting properties of epinephrine to delay absorption

TABLE 2.—INFILTRATION ANESTHESIA: WHEAL TEST* (MAN)

Compound	Minimal Anesthetic Concentration Per Cent	Efficiency Ratio (Cocaine = 1)	Toxicity (Cocaine = 1)
Butyn	1/128–1/64	2	1.0–1.5
Cocaine	1/64–1/32	1	1.0
Procaine	1/64–1/32	1	0.14–0.2
Nupercaine	1/640–1/160	5	2–5

*0.1 cc. intradermal.

TABLE 3.—NERVE BLOCK: FROG SCIATIC NERVE TEST

Compound	Minimal Anesthetic Concentration Per Cent	Efficiency Ratio	Duration of Action (Cocaine = 1)
Butyn	1/32–1/16	8	1
Cocaine	1/4–1/2	1	1
Procaine	1/4–1/2	1	1
Nupercaine	1/48–1/6	3–12	3–12

of the anesthetic agent, thereby prolonging anesthesia and diminishing the toxicity of the cocaine. In spite of this development, however, untoward symptoms continued to be of such frequency that a compound having the local anesthetic properties of cocaine was sought. In 1905, Einhorn succeeded in synthesizing procaine (novocaine). Here was a drug having the anesthetic properties of cocaine, with about one-seventh its toxicity. Unfortunately, procaine had one serious drawback in that it had no constricting effect on the blood vessels such as occurs with cocaine. It became necessary, therefore, to add a vasoconstrictor to further increase the margin of safety of procaine and to make it as effective a local anesthetic from the standpoint of duration as cocaine. The addition of epinephrine accomplished this purpose, but the solution is still short of being the ideal anesthetic agent.

TABLE 4.—FROG HEART PERFUSION

Cocaine	100
Procaine	6
Alypin	210

An ideal anesthetic solution should be sterile, and it should be capable of producing profound anesthesia, rapid in action, and of sufficient duration to permit the usual dental operative procedures, with the minimum of undesirable after-effects. It should contain a vasoconstricting agent that does not cause unfavorable symptoms or elicit toxic reactions when properly administered, and it should conform as nearly as possible to the physiologic laws and functions of the living cells.

A general survey of experimental studies that have been made in connection with the various local anesthetic and vasoconstricting compounds in an effort to find an ideal local anesthetic solution will permit a better understanding and proper evaluation of facts available at the present time.

ANALYSIS OF EXPERIMENTAL STUDIES IN CONNECTION WITH LOCAL ANESTHETIC AGENTS

The accepted methods for determining the concentration per cent, efficiency ratio, toxicity and duration of action of local anesthetic solutions, are by:

1. Nerve block; e.g., standard frog sciatic nerve method.
2. Efficiency on mucous membrane, and on the human cornea and the rabbit cornea.
3. Injection efficiency, by the standard wheal test on man.
4. Toxicity, by subcutaneous and vein administration on guinea-pigs, rats, cats and dogs, which also furnishes an index on respiration, heart action and circulation.

In making a survey of local anesthetic agents that have been used clinically, some more extensively than others, a comparison as to their local effects, tolerated dosages, systemic toxicities and therapeutic margins of safety has been made in Tables 1, 2, 3 and 4.

These data indicate the fallacy of evaluating the anesthetic efficiency of a product on the basis of one test only. The broad field of usefulness can be determined only by noting the efficiency under varying conditions, thus taking into account the variability as to absorption. The final analysis, in any case, must be governed by the margin of safety or the ratio between the effective and the minimal toxic dose. For general usefulness, combining the maximal efficiency and minimal toxicity, procaine is easily the local anesthetic of choice today as in 1905.

EVALUATION OF VASOCONSTRICTOR COMPOUNDS OF IMPORTANCE TO LOCAL ANESTHESIA

The practical usefulness of any local anesthetic depends primarily on the abolition or the blocking of sensory impulses from the field of operation. In order to accomplish this with the local anesthetic agents available today, the addition of a

vasoconstrictor in some form is necessary to prolong anesthesia and to lessen the tendency toward toxic reactions due to too rapid absorption of the injected solution, thus facilitating dental operative procedures and eliminating as far as possible any systemic effects due to mass absorption of the local anesthetic injected.

be classified as Group I: Pyrocatechin derivatives: epinephrine and arterenol; Group II: Benzol derivatives: ephedrine, cobefrin and benzedrine, and Group III: Phenol derivatives: synephrin and neosynephrin.

The practical usefulness of such vasoconstrictors is best illustrated in Table 5,

TABLE 5.—INFLUENCE OF SERIES OF VASOCONSTRICTOR COMPOUNDS ON SUBCUTANEOUS TOXICITY OF STRYCHNINE IN MICE*

Medication (Subcutaneous)	Concentration of Vasoconstrictor Administered Per Cent	Minimum Lethal Dose in Mg./Kg.	Ratio of Toxicity to Epinephrine as Unity	Strychnine Reactions Ten Mice per Group	
				Survived	Killed
Strychnine	—	—	—	0	10
Strychnine + adrenalin HCl	1	5	1.0	6	4
Strychnine + cobefrin HCl	1	30	0.1–0.16	8	2
Strychnine + stryphnon HCl	50	750	0.0066	9	1
Strychnine + synephrin Tnt.	50	1250	0.004	7	3
Strychnine + neosynephrin HCl	10	125	0.04	6	4
Strychnine + ephedrine HCl	50	500	0.01	8	2
Strychnine + ephetonine HCl	50	500	0.01	9	1

Controls received 2.13 mg. of strychnine (subcutaneously) per kilogram. All treated animals received strychnine in the same dose as the controls, plus the vasoconstrictors in a single injection at one site.
*H. Rotter, 1936.

TABLE 6.—RELATIVE TOXICITIES

Compound	M.L.D. Intravenous Mg. per Kg.	Ratio of Toxicity (Epinephrine = 1)	Oral M.L.D. Mg. per Kg.	Ratio between Oral and Vein Toxicity: Oral Toxicity / Vein Toxicity
Epinephrine HCl	0.1	1	50	500
Cobefrin HCl	1.0	0.1	200	200
Ephedrine HCl	70.0	0.0014	400	5.7

A study of the relative effects of a series of vasoconstrictor agents on intravenous administration to cats indicates, on the basis of dosages, the following order from greatest to least: epinephrine (1); arterenol (1.2); cobefrin (3 to 6); neosynephrin, ephedrine (350); benzedrine (425).

The prolongation of anesthesia and the maximal limitation of systemic toxicities of local anesthetic compounds is best accomplished by the combined use of an anesthetic agent with the maximal efficiency and greatest margin of safety and a vasoconstrictor of the epinephrine type. The more important of these compounds, from a clinical standpoint, may

which shows the limiting effects of vasoconstrictor compounds on the absorption of lethal dosages of strychnine administered subcutaneously to mice.

The relative toxicities of three well-known hypertensive compounds following oral and vein administration in rats are illustrated in Table 6.

The practical importance of a com-

pound which combines a moderate local vasoconstrictor effect with a proportionately smaller systemic effect on absorption is emphasized by our clinical observations on procaine solutions in combination with epinephrine in varying concentration, and cobefrin hydrochloride, reports of which have previously been published.[7]

CONCLUSIONS

The accumulated information in regard to experimental and clinical experiences with local anesthetic solutions and their reactions in relation to tissues, and an evaluation of local anesthetics and vasoconstrictor agents, are presented with the object of clarifying certain points in relation to the nature, efficiency and modes of action of preparations in general use in the field of clinical dentistry. The results appear to indicate that:

1. Procaine (novocaine) is the most effective and safest local anesthetic agent available at the present time.

2. All local anesthetic compounds available at present must be combined with a vasoconstrictor in some form in order to avoid toxic reaction due to too rapid absorption and to prolong anesthesia for a sufficient length of time.

3. Of the available vasoconstrictors, epinephrine, cobefrin and neosynephrin seem to be the most desirable for dental operations.

4. Weaker concentrations of epinephrine in combination with procaine will produce less pronounced change in blood pressure, pulse rate and the tendency to disturbing clinical reactions. The epinephrine content should not exceed 1 :50,000 concentration.

5. The use of cobefrin hydrochloride in sufficient concentrations to prolong anesthesia for dental operative procedures gives rise to even less change in blood pressure and pulse rate and produces fewer undesirable clinical reactions.

6. Neosynephrin in combination with a local anesthetic has not had extensive use in dentistry, although several have reported favorably on its action.

7. It is hoped that the material presented will broaden the general information of the dental profession; permit a more critical viewpoint, a better understanding of products in use and more careful observations as to anesthesia, and, perhaps, result in further advances of practical benefit to the patient and to the practitioner.

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MECHANICAL TREATMENT OF DENTAL ANOMALIES

By B. E. Lischer, D.M.D., F.A.C.D., St. Louis, Mo.

SOME historians maintain that Pliny, a prolific Roman author of the first century, was the first to recommend *mechanical* treatment of dental anomalies. That this form of treatment was not universally employed at such an early period may be inferred from the fact that Celsus, a contemporary of Pliny, advised cutting of the gums and timely extraction of deciduous teeth as additional remedies. Other forms of surgical therapy, such as the correction of clefts of the palate, operations for removal of hypertrophied tissue of labial frena, for resection of the mandible, for extraction of supernumerary and impacted teeth and the judicious extraction of certain permanent teeth, have been developed since then and more or less widely adopted.

In 1918, Rogers recommended several definite forms of exercise for certain muscles of mastication and for adjacent facial muscles as potent additional aids in the treatment of specified anomalies. These exercises constitute a group of methods which we designate by the term myofunctional therapy.

Our changing conceptions of bone formation and growth, of the mechanism of bone resorption and apposition, of metabolism and nutrition, of endocrine dysfunction, of vitamines and hormones are definitely disclosing the urgent need for a rational medical therapy, as well as establishing the criteria for its use.

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It is certainly known that many dental anomalies do not improve without treatment of some kind and that surgical, myofunctional and medical therapy, without mechanical assistance, are only partially effective. Preventive measures may abide in a clearer knowledge of causative factors, in infant nutrition and in rational hygiene, but the necessity for mechanical treatment of anomalies will undoubtedly remain. As stated above, dental anomalies have been recognized and treated for twenty centuries, but it is only in the last fifty years that precise and systematic attempts have been made to correct them. Progress in this branch of dentistry was very slow until professional apathy and lay prejudices were partially overcome by the admirable enthusiasm and great ability of a few pioneers.

Reliable investigations have shown that the incidence of dental anomalies in some communities amounts to 50 per cent in children under sixteen years of age, whereas mutilations of the denture presenting total loss of teeth (for which complete denture prosthesis was developed) do not approach this frequency until the sixth decade of life. It is impossible to foretell how many years of education of the profession will be required to raise dental orthopedics from a subordinate place in the curricula of our dental schools to its rightful rank as a major clinical division, and to increase instruction in it at least to a parity with dental prosthetics.

Notwithstanding many recent advances in our methods of correcting these deformities, the possibilities and value of

orthodontic service are not as widely appreciated as they deserve.

Every practitioner of wide experience meets with difficulties and failures in treating dental anomalies and ultimately he may learn that his failures are not always due to the inefficiency of the appliances he uses. The patient's teeth respond readily enough in most instances but they simply will not remain in their newly established relations after mechanical treatment is, presumably, completed. In other words, several of the difficulties encountered lie much deeper than mechanical technic.

Observations by discerning internists and pediatricians and investigations by pathologists have shown that the bony structures of the body are influenced by nutrition and certain endocrine functions. Bones are no longer regarded as definitely fixed structures: they are constantly changing, especially in children. That is why some orthodontic patients are poor risks for any kind of mechanical treatment. Fortunately, adequate preliminary roentgenographic examinations enable us to discover the presence of morbid bone conditions which hinder treatment.

For successful treatment of anomalies, even under favorable conditions, it is necessary to plan all procedures systematically in advance and then execute them in logical sequence. Such a method of action improves one's skill and reduces the number of failures.

EXAMINATION

The first examination of a patient should not be regarded as a consultation, because not all of the necessary diagnostic data are available during such an interview. Any professional advice which is proffered at this time should be of a general nature; one must learn to avoid promises which are too generous, and refrain from expressing uninformed opinions. Procuring the necessary diagnostic data is the most important preliminary procedure, for which definite appointments are generally desirable. Many practitioners underestimate the fundamental value of a diagnosis. Lack of cooperation by the patient or the inefficiency of the appliances used is frequently blamed for failures which spring from mistaken diagnoses.

The number and kind of data which must be obtained before a conclusive diagnosis can be made of a given anomaly vary only slightly. A written case record, photostatic facial reproductions, gnathostatic denture reproductions and the customary roentgenographic films usually contain the essential facts. The judgments of physicians, in those instances wherein the general health and the condition of the nasal passages and tonsils become factors in a given treatment, should also be procured and entered in the case record.

After these necessary data have been assembled, the practitioner is prepared to study the probable etiology of the anomaly, conclude his diagnosis and venture an opinion as to prognosis. An important office routine claims consideration at this juncture, namely, the compilation of a comprehensive index of all the important data which each patient presents. Time will not permit a description of such an index, but if the noteworthy characteristics of a given case are not indexed as they are entered in the case record, they are easily forgotten and become very inaccessible for comparative study. A cumulative cross index, on the other hand, enhances their value.

DIAGNOSIS

The diagnosis of a dental anomaly is a decision as to its true nature, a classification of its dysfunctions, deformities and dentofacial relations, an evaluation of the amount of all its deviations. The deviations of form and function are not infrequently so extreme that if they are not corrected, they result in arrested development of the lower half of the face and predispose the teeth to caries and to diseases of

the paradentium in adult life. The extent or degree of deformities may be determined by the use of photognathostatic methods of diagnosis recommended by Simon.

The next step is to prepare a treatment plan, including a sketch of the appliances to be used in a given case. Such a sketch is not only helpful throughout the course of the treatment, but also records the changing modes of mechanotherapy. And in the subsequent presentation of a case record, the accuracy and value of a case report are increased if a treatment plan made at the time of treatment is available.

After these preliminary details have been properly prepared, we are ready for the consultation. During this conference, it is expedient to discuss the probable time required by, and the conditions of, a mechanical treatment, as well as the prognosis of the anomaly. Not infrequently, a postponement of mechanical aid is indicated. For example, when a young child with a mixed denture presents a mere malposition of one or more teeth without malformation of the jaws, we classify the condition as eugnathic and defer treatment to some future time when it may be more opportune, or when it may be just as effectively consummated and include all possible deviations, as well as reduce the time when appliances must be worn.

On the other hand, when the jaws are deformed or arrested in their development and the facial form is involved, we classify the anomaly as dysgnathic and the prognosis is not favorable. Corrective measures are usually applied earlier to anomalies of the latter group. Obviously, the amount of the malformation and the accompanying malfunctions are important factors to consider in such instances. The gnathostatic diagnostic data enable us to measure and evaluate the amounts, so that we may arrive at conclusions with considerable precision.

After mechanical treatment has been found necessary, the construction of appliances is begun. So many methods of corrective treatment are now available that the practitioner has a generous list from which to choose. He may exercise considerable option as to the materials he employs, provided his decisions are based on the necessary data. He may also express his preference for appliances made indirectly, at least in part, on reproductions of a patient's denture, instead of making them directly on the natural teeth. But there is one course he must follow, regarding which there can be no alternative; namely, the appliances which he uses must be designed and assembled in his office and not by technicians in a commercial dental laboratory.

TREATMENT

Appliances should never be placed on the teeth until adequate preparative treatment has been provided. A thorough cleaning of the patient's teeth, instruction in oral hygiene and the complete elimination of dental caries and other diseases or affections are the essential items of such preliminary care. There are very few anomalous dentures in need of corrective measures which do not require this care.

Special appointments are necessary if the tooth bands of an appliance are made directly on the teeth, and for their final placement. For the construction of the bands, the teeth are previously separated and this separation should be maintained until the bands are cemented in place. Considerable skill can be acquired in the construction and application of appliances and the prevention of pain can be achieved. Another precaution which should be considered at this time is the partial, or gradual, placement of the appliances, and the postponement of active pressure until the patient has become accustomed to them.

An orthodontic appliance is a mechanism for the application of force to the teeth and their supporting tissues, to produce changes in their relations and to control the growth and development of

these structures. The forces liberated by an appliance ". . . should be as delicate as possible, so that the effect upon the involved tissues is confined within biologic bounds. Extreme, severe forces produce tissue disturbances which may lead to root resorption, permanent loosening of the teeth, death of the pulp and other pathologic lesions. Recent investigations have shown that the forces should also be continuous in action, that intermittent pressure should be avoided if healthy response of the tissues is looked for with confidence."

An important aid in the control of forces during active treatment is the development of a technic for their measurement at each application. For many decades our sole reliance was that of clinical experience, which the beginner finds difficult to acquire and which is rarely decisive or authoritative. For these reasons, measuring instruments have been devised and the optimal force for tipping movements of single-rooted teeth, for example, has been placed at 20 gm.

The media employed for transmitting forces have varied considerably and we have not reached finality in this detail, but two principles claim our attention at present. One is the custom of banding each tooth and providing fixed, rigid attachments with delicate brackets and tubes, with the emphasis on the need of bodily movement of all teeth, and the goal mechanical perfection; the other, the use of delicate springs carried by a simple base wire to produce mild stimulation of the supporting tissues and thus induce development, rather than correct deformity. It should be noted that in each method ligatures are eliminated and frequent visits to the office reduced to a minimum and injury to the gingivae is avoided. During treatment, it occasionally becomes necessary to alter the appliances to overcome a complication and, in case of accident, to repair or replace them.

In most cases of dental anomalies, it is desirable to construct post-treatment appliances after the active treatment has been completed, to maintain the teeth in their proper relations and to prevent a recurrence of the deformity. The design of these appliances should be recorded on the sketch-sheet mentioned above and their construction must be accurate. During the brief period after the active corrective appliances have been removed and just before the new passive appliances are placed, the teeth are again thoroughly cleaned and carefully examined for caries and other lesions. At this time, it is generally desirable to procure additional plaster denture reproductions, photostatic facial reproductions and roentgenographic records of the roots and bony structures for comparison with original conditions, and for recording the progress of the treatment.

The application of post-treatment appliances usually offers no serious difficulties, except that some of the teeth are very sensitive to the pressure required for constructing new tooth bands. For this reason, some practitioners design these secondary appliances at the beginning of treatment, and construct the requisite number of tooth bands before tooth movement is begun. These bands are put away until they are used in the secondary appliances.

It may not be amiss to state that all tooth bands are carefully set with cement and all uncemented contact points are reduced to a minimum. The time required for successful post-treatment maintenance varies considerably and no fixed rules can be laid down for our guidance. In many instances, certain arch wires of these secondary appliances are designed to be removable, so that a test period can be employed without complete removal of all tooth bands. The thorough hygienic care of the teeth during the entire period of maintenance should be just as exacting as during the active corrective treatment.

After the entire treatment has been completed and all appliances have been

removed, the teeth should again be thoroughly cleaned. At this juncture, additional data should be procured for the case record. Observation of the patient's denture should be continued at periodic intervals until all of the permanent teeth have erupted and complete and correct anatomical relations have been established.

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SECTIONAL COMPOUND IMPRESSIONS IN PARTIAL DENTURE CONSTRUCTION

By Luzerne G. Jordan, D.D.S., Washington, D. C.

THE selection of an impression technic for use in partial denture construction is not a simple problem. It may be determined by the ultimate design of the partial denture, the nature of the anatomic structures available for denture support, the type of working cast or master cast desired and by the operator's established method of procedure.

If the majority of partial dentures now being worn could be classed as entirely satisfactory, it could be assumed that the methods of construction most commonly used were acceptable. This is not the actual condition, however, and it must be admitted that removable partial denture service as generally practiced today is in great need of improvement.

Successful partial denture construction is without doubt the most complex subject in the field of restorative dentistry, involving a thorough knowledge of biologic and mechanical laws and requiring careful planning and designing. From the beginning of the procedure, there is not a single step that is not determined to some degree by the others.

Impression making is of course one of the important phases of partial denture construction, and this paper will deal primarily with the technical procedures involved in the making of sectional compound impressions. But, first, how shall the operator proceed in selecting an impression technic for any given case? Unlike full denture support, which is obtained principally from yielding tissues, partial denture support may involve either yielding or non-yielding tissues, or both (mucosa and natural teeth).

While at rest, the mucosa and underlying soft tissues do not offer sufficient resistance to the occlusal stresses to be of value in denture support, and it is only after the resiliency has been overcome and the soft tissues have been compressed to a state where they offer resistance equal to the load placed upon them that they become of proper service to the prosthesis. Many partial dentures fail to afford proper occlusion with the opposing teeth because the operator did not recognize this fact and make special provision to meet the condition either during construction or before the denture was delivered.

There are two principal methods whereby provision may be made to assure resiliency or displacement of the mucosa beneath partial denture saddles. One method incorporates tissue compression in the impression making; the other consists of rebasing the saddles either during construction or after the denture is made, the latter permitting the use of impressions which do not cause tissue compression.

This brings up the subject of rebasing procedures, which in the past seems to have been given too little consideration

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and which alone would warrant a lengthy essay.

It does seem that the use of so-called biting pressure should be avoided, during both partial denture construction and subsequent rebasing procedures. This statement applies especially to distal extension or similar cases, which include the use of indirect retainers and where the previously established relationship between the metal framework and the natural teeth may easily be lost, with undue strain, being directed to the abutment teeth, resulting in premature failure of the prosthesis.

Compression of the soft tissues under partial denture saddles, if desired, should, for many reasons, be accomplished during impression making. It is possible with

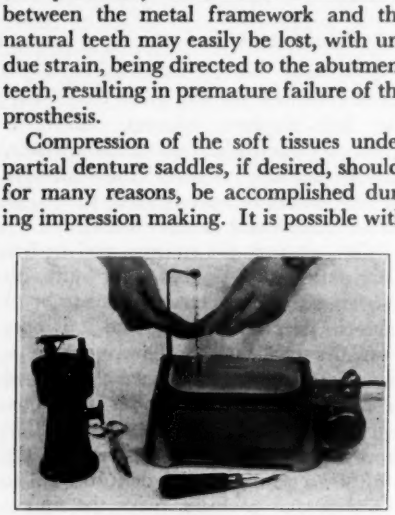

Fig. 1.—Manipulation of modeling compound to develop maximum working properties.

certain combinations of materials such as plaster or paste-like washes in modeling compound or other special types of trays, but I have found sectional compound impressions to be superior to all others for this purpose.

What are the requirements of an ideal impression material in partial denture construction?

1. It should permit of soft tissue compression when and where desired.
2. It should permit stability tests.
3. It should permit of testing for tissue adaptation.
4. It should permit of tissue trimming at the borders (muscle trim).
5. It should permit the correction or rebasing of local areas without the remaking of an otherwise satisfactory impression.
6. It should permit accurate recording of all natural tooth surfaces, contours, inclinations, occlusal rest areas and any other details pertinent to the proposed partial denture.
7. It should permit the use of amalgam or electrodeposited copper for the reproduction of the natural teeth on the master cast.
8. It should not shrink or expand when changing from the plastic to the hardened or finished state.
9. The surface of the finished impression should not require the addition of varnish before filling with cast material.

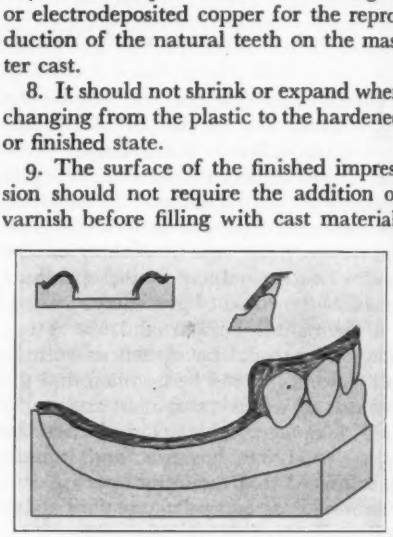

Fig. 2.—Impression tray conforming to general outline of area to be recorded and sufficiently oversize to provide for uniform layer of impression material.

10. The impression material itself should not be compressible when confined in thin layers, unless this resilient property can be prevented from acting to cause a change in the impression after it is released from contact with the tissues.
11. It should permit proper boxing before the cast is made.
12. It should permit removal from the mouth *en masse* without fracture or distortion.

The ideal impression material for partial denture construction would be one that meets all of the foregoing requirements, but to date no such material is

available, and it remains for the operator to determine the requirements of each individual case and select the material or combination of materials which will assure the best possible results in the finished denture. Modeling compound, plaster of Paris, the hydrocolloidal materials and the more recent cement-like substances constitute the materials in general use today. Combinations of these materials are frequently used. Dr. Rudd developed a technic for using plaster of Paris as a wash in a modeling compound tray. Kennedy and others have contributed to the subject of sectional compound impressions.

Certain operators still insist that plaster of Paris is best. Others use the hydrocolloidal materials exclusively. It is not uncommon for operators to change from one material to another without expending the time or effort necessary to become proficient in the use of any one; a practice which, of course, cannot be expected to produce exact results.

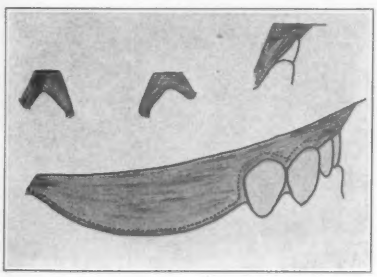

Fig. 3.—Cross-sections of compound block made on preliminary cast. When the tooth and tissue surfaces are heated to a uniform depth, the rigid portion becomes slightly oversize and the soft material on the surface serves as the impression material.

Sectional impressions made of modeling compound will satisfy the majority of the listed requirements, and the balance of this paper will be devoted to a description of the technic of making such impressions.

MANIPULATION OF MODELING COMPOUND

Modeling compound exhibits very useful properties when it is properly handled. It should not be allowed to lie on the bottom of the water pan over a flame or hot plate, as this portion of the pan becomes extremely hot and the compound will be burned. Such heating devices should be provided with a cloth-covered framework to support the compound near the surface of the water. Some heaters are provided with heating elements located near the water level on the outside of the pan. In such heaters, the compound may remain on the bottom of the pan for a long period of time without being burned. (Fig. 1.)

Before the compound is placed in the impression tray, it should be thoroughly manipulated in a manner similar to pulling taffy, in order to assure uniform consistency and to improve its working properties. During this procedure, it should be returned to the hot water frequently to avoid chilling the surface.

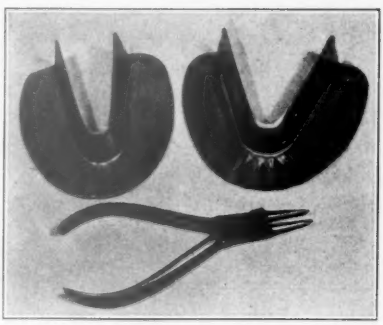

Fig. 4.—Trays designed for making sectional compound impressions of lower tray. These trays are standard size and large enough for all cases.

The water temperature in the heater should be maintained at about 140° F. to assure thorough softening of the material and to temper the flame-softened surfaces sufficiently to prevent burning of the oral tissues.

Instruments used for cutting compound should be very sharp and present a fine saw tooth edge. The leather cut-

ter's knife is easily sharpened and is very efficient for this purpose.

Unlike many other impression materials, modeling compound can be hardened quickly with cold water. The importance of thorough chilling should not be overlooked, and a pan of cold water together with a large quick-filling syringe should always be at hand when this material is used. Ice water is excellent for chilling, but may prove painful to the patient if it comes in contact with the natural teeth. The surface of modeling compound should not be burned or blistered in heating with a flame. Burning destroys the inherent qualities of the material and leaves hard particles which interfere with the making of a smooth impression.

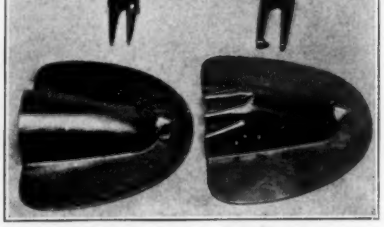

Fig. 5.—Reshaping of upper tray, which is usually required to make it conform to palatal curvature. Holes are punched in the trays to assure retention for the compound.

PROCEDURE

Previous to impression-making, all operative procedures on the remaining natural teeth and contiguous tissues should be completed. As a result, the crowns of the abutment teeth should present the desired contours and long-axis inclinations. That part of the preparatory work most frequently neglected pertains to the occlusal rest areas on the abutment teeth. Ample space should be provided on the occlusal surfaces of the abutment teeth to allow for strong occlusal rests on the clasps.

The partial denture procedure should be such that proper occlusion is reestablished by the occlusal rest in the finished denture.

PRELIMINARY IMPRESSIONS

It is my opinion, after many years of experience, that preliminary casts are essential to the construction of well-made impressions, and this is particularly true in partial denture work. These casts serve as foundations on which to construct impression trays for making the final impressions.

An impression of an irregular surface should be made in a tray which presents the same general contours as the surface to be recorded. The surface of the preliminary cast is ideal for making such

Fig. 6.—Compound block properly trimmed about teeth.

trays for partial denture impressions.

Preliminary impressions may be made with modeling compound in impression trays of the orthodontia type. After it has been filled, the tray should be allowed to stand until the compound has stiffened slightly. The compound is then flashed with a needle flame to remove surface irregularities and to provide a shallow layer of very soft material for contact with the teeth and tissues. After tempering in water at 140° F., it is taken to the mouth, where sufficient pressure is applied to orient the tray. The semi-stiff compound serves to support the soft surface layer and force it into close con-

tact with the teeth and soft tissues. The compound, if left uniformly soft throughout, escapes more freely from under the tray, is not properly forced into the deeper areas (as high palates) and is generally deficient in surface detail.

Before the material has completely hardened, the impression is partially removed (about 2-3 mm.) and very carefully reseated with firm pressure. This serves to break any locking due to undercuts, and the reseating corrects any resulting occlusal surface distortion.

The partial cooling or stiffening of compound, followed by flashing the surface before insertion in the mouth, will be found advantageous in all types of impression work wherein modeling compound is used.

Preliminary impressions can usually be overextended to advantage and should always include all areas desired in the finished impression.

PRELIMINARY CASTS

Preliminary casts should be made of artificial stone to provide proper strength for forming the final impression tray. The difference in cost between artificial stone and plaster of Paris is not sufficient to warrant the repetition of the preliminary impressions because of fractured casts.

FINAL IMPRESSION TRAY

The ideal impression tray for final full denture impressions is not one which exactly fits the area to be copied. Instead it should be slightly oversize, when properly oriented over the ridges, to provide uniform space for the plastic impression material which is to be placed on its surface.

The application of this principle (Fig. 2) to partial denture impression making is easily accomplished by the use of the sectional compound technic. The rigid compound block (supported by the metal tray) formed on the preliminary cast fits as accurately as would any form of tray made on the same cast. When the tooth and tissue surfaces of the compound are heated to a uniform depth, two important results accrue: (1) the rigid portion of the compound block is made oversize, and (2) the softened layer of compound on the surface is ready to serve as the plastic impression material for making the final impression. (Fig. 3.)

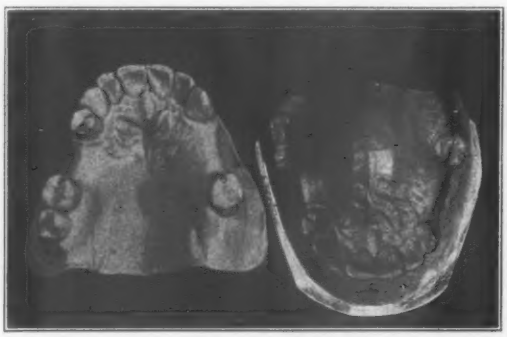

Fig. 7.—Preliminary cast and compound block. The compound has been properly trimmed about the teeth and edentulous areas.

The metal tray and compound block are prepared in the following manner:

An adjustable metal tray is formed over the preliminary cast so that it will

properly support the modeling compound that is to be interposed between it and the cast. It should extend buccally and labially beyond the natural teeth to form a shelf, and it should provide a space of at least one-quarter inch between itself and the cast at all points.

Lower impressions especially should conform to the arch outline presented by the cast. The lingual flange should be reduced, if necessary, to allow proper tissue (muscle) trimming of the anterior portion of the lingual border.

Upper impression trays should be reformed at the posterior border to avoid encroachment on the downward curving soft palate. They need not extend so far buccally over edentulous areas as

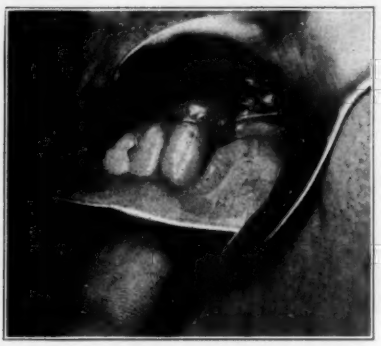

Fig. 8.—Trying compound block in mouth. When the block is tried in the mouth, spaces will be evidenced at the proximal aspect of the abutment teeth. Extra compound is added to the compound block in these areas before the surface is heated and the impression is finished.

where natural teeth are present, and need not conform to the general surface irregularities of the cast, except as stated, because the interposed modeling compound will reproduce such surfaces.

The trays illustrated (Figs. 4 and 5) were especially designed for sectional compound impression making and are sufficiently large to fit all cases. The lower is adjustable to arch form by accentuation or decrease of the lutings in the anterior region. (Fig. 4.) The upper may be widened by flattening the palatal curvature. Holes are punched inward through the walls of the tray to aid in the retention of the compound on its surface.

The preliminary cast is placed in a pan of tepid water and allowed to become completely soaked. A generous amount of well-manipulated compound is seared to the surface of the dry tray and formed to receive the wet surface of the preliminary cast.

Considerable care must be exercised to assure proper orientation of the tray over the cast and to prevent the cast from penetrating the compound and thus leave too little material between the cast and the tray. It must be remembered that the surface of the compound is to be softened

Fig. 9.—Forcing to position compound block with surface uniformly softened. Excess material is forced from under the teeth and soft tissues.

later and this will bring the metal tray into even closer contact with the teeth or tissues. At this stage, the metal tray should be no closer to the cast than one-quarter inch at any point. It will be necessary to shape the compound with the fingers on the buccal surfaces over the edentulous areas, owing to the absence of side walls on the metal tray. The material should be left quite thick in these areas to support the inner surface compound when it is later softened and forced against the tissues.

The compound is partially chilled and

removed from the cast. The surface is examined and, if satisfactory, the compound is again seated on the cast, where it is completely chilled.

If it appears that the tray has penetrated the compound, leaving too thin a layer of the latter, or that it has drifted to one side during positioning on the cast, the compound should be removed from the tray and the procedure repeated. The compound so formed is to remain firmly attached to the metal tray throughout future impression-making, and this assembly will hereafter be referred to as the compound block.

To obtain in full the advantages of sectional compound impressions, the compound block must be carefully trimmed before it is taken to the mouth and throughout all impression procedures.

Fig. 10.—Inspection for accuracy. After the excess material is trimmed away, the block is returned to the mouth and carefully inspected.

The buccal, labial or lingual regions of extensive edentulous areas should be included in the compound block similarly to full denture impressions. (Note the buccal and lingual side walls distal to the natural teeth.) (Fig. 6.) The compound block should include as much as possible of the soft tissue areas, but should be trimmed back to expose at least one-half or two-thirds of the proximal surfaces of the abutment teeth which face the edentulous areas. The block should include all occlusal surfaces and incisal edges of the natural teeth, but at the junction of the occlusal surfaces and incisal edges with their respective buccal or labial surfaces, the compound should be cut to slope toward the metal impression tray. Some operators make the mistake of including a portion of the buccal or labial surfaces of the teeth in the block portion of the impression, but this should, for many reasons, be avoided.

Figure 7 illustrates an upper block which has been properly trimmed. Note that the compound is cut to slope away from the tooth and tissue surface of the compound to the metal tray.

The buccal or labial flange of short edentulous areas presenting natural teeth at each extremity should also be reduced to include the crest of the ridge only. These areas are later recorded in the buccal and labial sections of the impression.

Fig. 11.—Completed impression with buccal and labial sections in compound. The sections are held firmly in place and luted together on the outside surface with a hot spatula.

The lower jaw may present molars with a pronounced lingual inclination. If these teeth are not to be altered with new crown restorations, the compound block should be constructed to include the occlusal and buccal surfaces of such teeth, and the lingual wall must be cut away to permit the recording of the lingual surfaces with an extra section. The tech-

nical procedure is the same as that used in making regular buccal and labial sections. A final check should be made to be sure the compound is firmly attached to the metal tray.

CHECKING THE COMPOUND BLOCK IN THE MOUTH

The compound block is carried to the mouth, where it should be carefully inspected for adaptation and stability. Gross errors can result only from a faulty preliminary impression or failure to properly adapt the compound block to the preliminary cast. The relation between the compound and proximal surfaces of the abutment teeth should be observed. In most cases, there will be evident in these areas a space due to distortion of the preliminary impression when it was removed from the mouth. (Fig. 8.) This is an advantage because it facilitates the formation of the compound block on the cast.

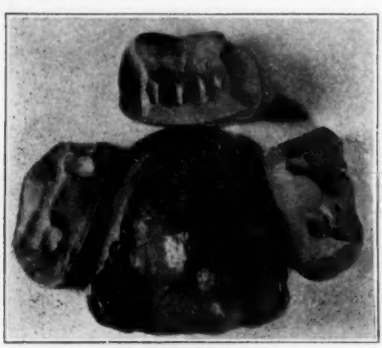

Fig. 12.—Buccal and labial sections. The buccal sections were made first and with the block portion were held firmly in position while the labial section was made. Compound or plaster may be used as illustrated for buccal and labial sections.

COMPLETING THE BLOCK PORTION OF THE IMPRESSION

The tooth and tissue surfaces of the compound are dried; extra material is added in the region of the exposed proximal surfaces of the abutment teeth, and, with the alcohol flame, the entire tooth and tissue surfaces of the compound are heated. Great care should be exercised to assure the formation of a uniform surface layer of soft compound without burning. The compound is then dipped quickly into water at 140° F. and carried to position in the mouth, where considerable pressure is applied to force the softened surface into intimate contact with the teeth and soft tissues. The pressure should be equally distributed and maintained over the entire compound block while the exuding soft compound is packed back toward the occlusal and incisal surfaces of the teeth, and especially against the proximal surfaces of the abutment teeth. (Fig. 9.)

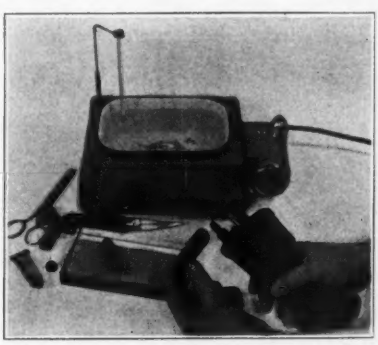

Fig. 13.—Modeling compound shapes being made ready for making buccal or labial sections.

If the block presents areas which include the entire edentulous ridge, as the distal border of lower impression shown in Figure 6, no attempt to tissue-trim the buccal, labial or lingual borders is made at this time. The compound in such areas should be pressed against the sides of the ridges to assure proper surface contact without regard for border extension. Tissue-trimming or muscle-trimming of the borders should always be delayed until completion of the basic portion of the impression when modeling compound is

used. The block is held in position until the material has been thoroughly chilled with cold water. It is then carefully removed from the mouth. The manner or direction of removal should be determined before this portion of the impression is made. The impression should be displaced first on the side of the mouth which presents the least number of natural teeth or undercuts. The compound should be sufficiently hard to assure fracture rather than drag (distortion) in the areas of minor undercuts. The impression is now chilled in cold water, and the tooth and tissue surfaces are dried and examined carefully. The excess compound, which has been forced out from under the teeth and short edentulous areas, is trimmed away, care being observed to expose at least one-third of the proximal surfaces of the abutment teeth with an opening sufficiently wide to allow easy entrance of the material later used in making the buccal or labial sections. The tooth and tissue surfaces are carefully examined and any small particles of compound which may have collected are removed.

Fig. 14.—Impression of lower jaw with labial sections made in both red and white compound. Lapping of sections onto parts already completed permits accurate assembly. The labial section was made in two pieces to prevent distortion on removal.

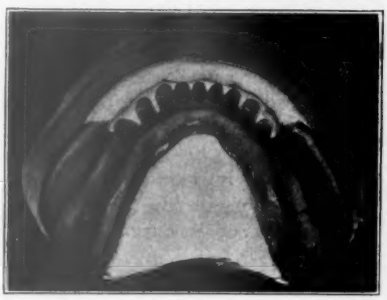

Fig. 15.—Completed impression, partially embedded in slow-setting plaster of Paris to lock sections together.

TEST FOR STABILITY

The block is placed in position in the mouth and carefully tested for stability. At this time, it must be remembered that the soft tissues were compressed when the final impression on the surface of the block was obtained. For this reason, the block should be held in position with pressure sufficient to overcome tissue compression while the stability tests are being made in the following manner.

Finger pressure is applied at various points throughout the block. If it rocks, as would a full denture which is without sufficient relief in the hard area, it is imperfect and must be corrected. This may be accomplished by one of two methods. The entire tooth and tissue surfaces may be softened and the impression procedure repeated until stability is obtained. I should use this method with impressions similar to the impression shown in Figure 12.

Distal extension or similar cases (Fig. 6) which lack stability in the saddle areas may be corrected by rebasing with compound. When this procedure is followed, the operator should never apply pressure over the area being rebased, but should confine the seating pressure to those areas which have been accepted as satisfactory. The rebased surface should be continuous with the remainder of the impression and should never present a difference in surface continuity.

If any portion of the impression sur-

face, such as the occlusal rest area in an abutment tooth, is lacking in proper detail, correction is made as follows. The area that is faulty is cut away to a depth of 3 or 4 mm., abrupt or right angle margins remaining, with the cut-away area extending to the outer or shelf surface of the compound block. If seated in the mouth, the cut-out portion would present a funnel-shaped opening leading to the area to be corrected. The surface is dried and a thin layer of molten compound is seared over the entire cut-out area, care being taken that this new material does not overlap the uncut areas, and also that the amount of compound placed in the inner extremity of the opening is less than enough to secure the impression. On the shelf portion of the opening, the compound should be heaped up to a generous excess. This procedure should be accomplished rapidly to prevent cooling of the compound. The new material is flashed with a needle flame and tempered in water and the block quickly seated in the mouth, where it is held firmly in position while the finger is used to force the excess compound, lying on the shelf, into the deepest portion of the cut-out area. After chilling, the block is removed and trimmed.

This simple procedure permits correction of local defects without repeating the entire impression procedure and without the danger that the new material may overlap previously satisfactory impression surfaces.

In his textbook "Partial Denture Construction," Dr. Kennedy recommends rebasing of upper impressions across the palate in those areas later to be covered by palatal bars, thereby securing added tissue compression and an intimate relationship of the finished bar to the tissues. I believe, however, that new material should never be added to confined areas on the surface of an impression, because the slightest excess, having no means of escape, prevents proper seating of the original impression and a distorted cast of the jaw results. If new material must be added to confined areas, one or more openings should be cut through the impression base to provide easy escape of excess material. Furthermore, the intimate relationship between palatal bars and the underlying mucosa should be established along the borders of the bar and not necessarily over its entire tissue surface; which is easily accomplished by scraping the master cast slightly along the borders of the palatal bar outline before the bar is cast.

TEST FOR TISSUE ADAPTATION

The tissue surface of the compound is dried and marked generously with an indelible pencil, especially over those areas later to be involved in the prosthesis. The block is seated in the mouth and firm pressure applied. It is then removed and the surface of the mucosa examined. Lines made on the compound should have been transferred to the tissues, thus indicating intimate contact between the two surfaces. If the transfer is not satisfactory, the surface of the block should be reheated and the impression corrected.

Most operators have had the experience of making palatal bar cases which did not properly contact the tissues in the roof of the mouth when finished. The possibility of such an error is very remote where sectional compound impressions are made and tested as described.

BUCCAL AND LABIAL SECTIONS

The buccal and labial surfaces of the teeth, together with any exposed surfaces of edentulous ridges, may be recorded in plaster of Paris or modeling compound. The beginner will find plaster easier to handle, but should take advantage of the superior properties of compound as soon as ability permits.

These sections are always made with the compound block portion of the impression held firmly in position on the ridge. The material used should be forced into intimate contact with the teeth, tis-

sues and shelf of the compound block, making a perfect union with the finished margins of the block. Spaces or crevices should not exist when the completed impression is later assembled outside of the mouth. (Fig. 11.)

The material used in making these sections may penetrate between the occlusal surfaces of the teeth and the compound block if the block was faulty or was not held firmly in position; in which case the impression should be corrected.

If the areas to be recorded by these sections are extensive, as in Figure 11, they should be in sufficient number to permit removal without distortion or fracture.

When separate sections are made, they should always overlap previously completed areas to form a key or guide in assembling later outside the mouth. (Fig. 12.)

The junction of separate buccal and labial sections should occur at the greatest convexity of a tooth in the direction of its long axis and never in an embrasure. This is accomplished by trimming the edges of those sections made first, whether of plaster or compound.

If the entire area is covered with one mix of plaster, fractures should be made along predetermined lines and the plaster removed in sections.

Plaster sections should always be closely examined for loose particles before assembling.

Since plaster of Paris generates heat during crystallization, the compound block should be held in position, after the plaster sections are removed, until it has been thoroughly chilled with cold water.

MODELING COMPOUND SECTIONS

Certain operators prefer to use small metal trays when making the buccal and labial modeling compound sections. These trays may be constructed of soft metal when the compound block is formed on a preliminary cast. As I find some difficulty in securing the desired detail when such trays are used, I use the following procedure.

A generous amount of new compound is softened and properly manipulated. It may be the type used in making the block, or a lower fusing white compound may be used. A piece of compound is formed into a small roll long enough to include the desired area and laid on a cold glass slab or metal surface, the fingers being used to form it into a long triangular shape, with the apex pointing upward.

The completed compound block, which has been lying in a pan of cold water, is seated on the ridge, where it is held firmly in position by the patient or the assistant until the operator is ready to place the new section material in the mouth.

A very thin layer of vaseline is applied to the apex of the prepared roll of compound and, with a needle flame, the exposed areas are flashed to remove surface irregularities and to soften the compound. (Fig. 13.)

By this time, the base of the material has been chilled sufficiently to maintain the desired form. It is removed from the slab, quickly dipped in water at 140° F. and carried to position in the mouth, where the soft portion is placed against the sides of the teeth and compound block with one or both ends overlapping portions of the impression already completed.

While holding the block, together with any previously made sections, firmly in position, the operator applies finger pressure over the new material to force the softened inner layer into contact with the teeth, tissues and shelf portion of the block.

The new section is now thoroughly chilled with a stream of cold water from the syringe. Distention of the lip or cheek is avoided during this procedure or the section may be displaced. When thoroughly chilled, this section is carefully removed from the mouth, but is not placed in cold water. All previously made parts of the impression are removed, assembled

outside the mouth, held firmly together and chilled. If, after careful examination, discrepancies appear, the procedure should be repeated. Each individual section should be acceptable before other overlapping sections are made.

Figure 12 illustrates a case requiring one labial and two buccal sections, permitting the withdrawal of each section without distortion or fracture of the material which had entered the embrasures. The buccal sections were made first and trimmed along their anterior ends to terminate as desired on the surface of the teeth. The anterior ends were made comparatively thin (not blunt) to facilitate access of material in making the labial section. V-shaped cuts were made to serve as keys in assembling the finished impression. The block and buccal sections were then returned to the mouth and held rigidly in position while the labial section was being made. Figure 11 shows the finished impression.

When plaster is used to make individual sections, the order of procedure is the same except that a separating medium is required to prevent locking together of the sections. With the compound block firmly seated, the lip or cheek is distended and the plaster is placed on the shelf portion of the block and well up into the vestibule. The lip or cheek is returned to its rest position and the operator forces the plaster against the tooth and tissue surfaces by gently tapping the overlying facial tissues.

When a record of vestibule borders is required, as might be the case in immediate full denture construction, plaster of Paris will prove more convenient than modeling compound and the tissues may be manipulated to produce the same type of muscle trimming desired in regular full denture impressions.

Figure 14 illustrates a case requiring two labial sections, which have been made in both white and red compound. Distortion would have resulted if the entire area had been included in one section of compound. A solid plaster section would have been provided with a cleavage line in the center and removed in two pieces after fracturing.

ASSEMBLAGE

After careful assemblage, the sections are locked together (1) by ironing of the joints on the outside with a hot spatula or (2) with sticky wax if plaster sections were used.

Plaster sections are varnished to produce a glossy surface. The surface of the modeling compound should not be varnished.

If amalgam is to be packed in the tooth impressions, the sections should be locked more rigidly together by immersion to a shallow depth in a mix of slow setting plaster. (Fast setting plaster generates too much heat.)

The plaster is molded about the sides of the impression so as to brace the sections and prevent their displacement. (Fig. 15.)

After the amalgam has thoroughly crystallized, the impression is properly boxed and placed in room temperature water until the plaster is thoroughly saturated. The impression is then dried and filled with a stiff mix of artificial stone. The plaster lock should be used even though an all-stone cast is to be made.

CONCLUSION

Partial denture construction is a lengthy procedure and the success or failure of the finished prosthesis may depend entirely on the accuracy of the final impression.

Sectional compound impressions render it possible for the operator to make tests which are similar in many respects to those usually made only with the finished restoration. This and other features have contributed to the high regard accorded sectional compound impressions by those operators who have used them in partial denture construction.

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ORTHODONTIA FOR GENERAL PRACTITIONERS

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DURING the past twenty years, the department of orthodontics has grown so completely apart from general dental practice that papers on general topics are seldom presented before groups of orthodontists, and papers on orthodontic subjects are seldom heard by general practitioners. Orthodontics and general practice have grown almost too far apart for the best good of the public. It is axiomatic that any specialist in any phase of medicine or dentistry should have a broad and thorough knowledge of the general field. This is especially true of the specialty of orthodontics.

Orthodontics occupies an anomalous position in dental science, in two respects. First, undergraduate education in orthodontics does not fit the graduate to practice it. The subject receives, on the average, about 50 hours out of a total of 5,000 in the dental curriculum. Operative dentistry (all phases) receives about 2,100 and prosthetic dentistry departments, about 1,100.

In many leading colleges the student does not treat orthodontic cases; the course is purely didactic and observational. In others he gets a limited clinical experience, inheriting many of his cases from the preceding classes, treating them by simple, crude and often obsolete appliances, and bequeathing them, unfinished, to the class which follows him. The student graduates into general practice with that most dangerous of qualifications—a little knowledge. Most educators realize that the graduate should have either a great deal more knowledge of orthodontics or so much less that he would have no thought of undertaking clinical orthodontic treatment.

One outstanding university offers an optional course in which the student may major in orthodontics, eliminating part of the prosthetic laboratory course to provide time for orthodontics. The student is fitted in all phases of clinical practice for children and young adults and is supposed to refer bridgework and artificial dentures to other practitioners; he is, however, licensed to practice prosthetics if he desires to attempt it. The point is that, with dentistry expanding constantly and all departments of the dental curriculum clamoring for more clock hours, there is not sufficient time available to adequately educate students in all departments of dentistry, *including* orthodontics. Most certainly the practice of orthodontics, whether as a specialty or in general practice, demands full training in all other phases of dentistry—and in the writer's opinion, prosthetics should be the last subject dropped from the orthodontist's curriculum.

Conditions being as they are, most of the schools have adopted a sane policy, giving their students sufficient knowledge of orthodontics to enable them to (1) pass the state board; (2) recognize incipient cases of malocclusion; (3) guide the young child in the hope of arresting tendencies to malocclusion, and (4) refer the patient to a specialist.

This provides very well for the city

(Read before the Section on Operative Dentistry, Materia Medica and Therapeutics at the Seventy-Ninth Annual Session of the American Dental Association, Atlantic City, N. J., July 14, 1937.)

practitioner, but the man who is to settle in the country, where specialists are not available, must somehow acquire sufficient knowledge of orthodontics to care for his young patients, and acquire it without blindly experimenting on children. A great responsibility is his; if an inlay fail, there is the coronal veneer; if the veneer fail, there is the bridge; then the partial denture. But if a child is ruined by orthodontic treatment, he is usually ruined "all over," and ruined for life.

The second anomalous phase of the position of orthodontics in dental science is that orthodontics in treating human dentures is treating a mechanism and yet treating it purely from the standpoint of esthetics. Human dentures are not merely teeth set in a row; they are a functioning organ whose health maintenance and functional efficiency depend upon mechanical factors. The coordinating of those factors is far more important than esthetics.

During the last two decades orthodontists have been concentrating upon the etiology of malocclusion, and the mechanical principles and intricate practical mechanics involved in treating it. They have made marvelous progress along those lines. They have not, however, been sufficiently aware that general dentistry has made an equally striking advance in the concept of dental practice in the large, and particularly in a realization of the importance of masticatory function, in the manner of synthesizing it, and in the insidious but far reaching syndrome initiated by traumatic or, as Endelman more properly calls it, *pathologic* occlusion.

Undeniably, many completed orthodontic cases which are most acceptable in appearance abound in occlusal deformities which render the dentures incapable of proper function, and subject to periodontal pathosis. Many orthodontists still practice in the age when intercuspation of teeth in centric closure was considered a guarantee of masticatory ability. The general practitioner, on the other hand, evaluates the returned orthodontic patient, whose future dental health now becomes *his* responsibility, from the more recent viewpoint that cusps which conflict in *any* jaw position hold the rest of the dentures out of occlusion so their functional ability in that position is nil, and at the same time subject the conflicting teeth to a periodontal stress calculated to produce havoc. Too often he recognizes that he will struggle in vain to prevent or arrest periodontal disease throughout the patient's adult life.

So the general practitioner, especially in periods of economic stress when his appointment book is not too well filled, is tempted to undertake orthodontic cases, feeling that, with his knowledge of the occlusal factors, he can perform a better orthodontic operation than the orthodontist. He, unfortunately, is unaware of the complexities imposed upon orthodontic treatment by modern knowledge of bone histology, physiology and pathology. When the general practitioner who has given no special study to the systemic and extraneous as well as the local etiologic factors, and to the technic of applying therapeutic force, undertakes an orthodontic case, he is playing with a buzz-saw and is even more certain to fail than is the orthodontist who has given no study to the occlusal factors. The general practitioner's failure will be one of which the patient and all who see him will be immediately aware, whereas that of the orthodontist may take years to reach fruition in periodontal pathosis and general ill health.

Both orthodontics and general practice have gone through a long period devoted to perfecting the mechanics of treatment. In the past, mechanics has been the basis of clinical practice, and as a result we have had, in general practice, gold-foil men; gold-inlay men; Tinker-bridge men; Chayes-bridge men, and Monson, Hanau or Wadsworth men. In orthodontics, we have had Angle men, Jackson

men, ribbon-arch men, edgewise-arch men and lingual-arch men.

Today, both of these branches of dentistry are emerging from the mechanical age, and are beginning to realize that it is not good practice to fit any type of dental case to a stereotyped formula of treatment. It is just as wrong to try to adapt all types of cavity to a gold-foil operation as it is to adapt all types of malocclusion to a given appliance. In the modern concept, all types of procedure become subservient to the major aim of dental treatment—which is to establish lasting oral health and function, as a health service to the patient. We are no longer treating just the teeth; we are treating the patient by way of his teeth.

Seen from this viewpoint, all dentistry has two major aims:

1. To eradicate and prevent oral and dental pathosis and infection. This includes caries and periodontal pathosis, and both general practice and orthodontics are intensely concerned with it. Tooth position may enlarge the susceptible areas of tooth surface, making the tooth prone to caries. Tooth position may lay the gingival crevice open to impact of food in mastication, making the tooth prone to periodontosis. Wrong axial inclination of teeth throws an unbearable stress upon their periodontium, making them subject to periodontosis. Wrong proximal contacts permit food to wedge in interproximal spaces, making the tooth prone to periodontosis.

2. The second aim of modern dental practice is to maintain masticatory function, to increase it when it is deficient, and to restore it when it has been lost. To accomplish this objective, which deals with the reason for the very existence of teeth, certain anatomic factors must be coordinated. The orthodontist must coordinate tooth position, which includes arch form and dimension and the occlusal curves, to tooth anatomy and the jaw movements. The general practitioner must coordinate occlusal tooth anatomy with the occlusal curves and the movements of the temporomandibular joints. Both departments are concerned with such factors as overbite and overjet; both are engaged in altering anatomic factors for the purpose of improving or creating masticatory ability.

The orthodontist when moving teeth in the jaws, the general practitioner when building occlusal restorations or performing the more complex operation of later life known as occlusal reconstruction, and the prosthodontist when creating artificial substitutes for teeth, all have the same objective: to produce efficient and nonantagonistic masticatory function with esthetics as a by-product. The fact that the patient usually considers appearance more important than function does not make it so. Function is necessary for periodontal health and for general health, and must be given precedence in the thought and prescription of both the general dentist and the orthodontist.

Seen as a health service, orthodontics takes on added importance in the scheme of things: its procedures become more difficult and time consuming, and the orthodontist's responsibility is vastly increased both to his patient and to his specialty, lest he wrong the one and discredit the other in the eyes of the general practitioner and the public.

If the prosthodontist finds it difficult to set up artificial teeth in wax so that they will cooperate fully in the jaw movements as reproduced on the articulator, how much more difficult it is to move teeth to the same relationships in the mouth by inducing osteoclastic and osteoblastic activity in the jaws. The prosthodontist moves one tooth at a time, and allows its wax support to harden before moving another. The orthodontist is moving all teeth at once; the periodontal tissues and supporting bone are in a state of flux, allowing teeth to move freely in any direction in which force is applied. Remember, too, that all orthodontic,

therapeutic force works in two directions at once; that tooth movements must perhaps occur in three dimensions at once, with tooth rotations thrown in for good measure. And keep in mind that tissue reactions to therapeutic force will be largely influenced by the patient's nutritional program and his endocrine control of mineral distribution and utilization.

From the standpoint of merely moving teeth to desired positions, the orthodontist's task is not one for the dilettante. From the standpoint of determining what the desired positions of teeth are, the science is more complicated still. Nature has a well-defined architectural plan for the development of the dentures, jaws and face; a plan whose objective is first function, and second, esthetics. That plan calls for chemical nutritional elements; for vitamin catalyzers; for a well-balanced endocrine control of metabolism, and for normal functional use of the parts. Lacking any one or more of these factors, development will be deranged or inadequate; there will be a malocclusion. The orthodontist is then called in to act for Providence; not to pull and haul teeth about blindly, but to be the guiding genius of the child's facial and oral development. It behooves the orthodontist to understand Nature's developmental routine and also her objectives. His work is much larger than the making of bands and the bending of wires. At the same time, the mechanics of his treatment, as expressed in bands and wires, has become exceedingly exacting and complex, and is so different from other routines in dental practice that it sets orthodontics apart as a science which requires much special study for its safe and effective practice.

ORTHODONTICS FOR THE GENERAL PRACTITIONER

Nevertheless, much orthodontic responsibility falls upon the shoulders of the general practitioner in preventing and detecting in incipiency conditions which will develop into malocclusion. Atkinson points out that it is no trick to tell a man from a crocodile; but it takes much knowledge to differentiate human from crocodile embryos. So, it is no trick to recognize the major malocclusions; but it takes some knowledge and considerable sharp observation to detect malocclusion at the incipient stage when one fork of the road leads to normal development, and the other to deformity.

At the age of three, when the deciduous denture is at its fullest development, the second deciduous molar stands under the malar process of the maxillary bone, called by Atkinson[1] the "key ridge." It is a well marked prominence rising from the alveolar process and blending into the malar or zygomatic arch. The permanent upper molars, developing in the jaw, are strung backward, upward and outward, around the maxillary tuberosities; the lower molars are strung backward and upward in the rami of the mandible. As the jaws develop, the teeth move forward and downward until, at 18 years of age, the first upper permanent molar's mesial root stands under the malar process.

This downward and forward growth of the dentures is guided between the balanced pressure of the tongue on the inside and the cheeks on the outside; it takes place against the restraining influence of closed lips. All malocclusions are caused by some abnormal influence upon this downward and forward growth of the dentures and face. The etiologic factors of malocclusion might therefore be divided, for simplicity, into three classes:

1. Deflecting influences.
2. Obstructing or inhibiting influences.
3. Influences permitting too easy forward movement of part or all of the denture, without proper accompanying jaw growth.

DEFLECTING INFLUENCES

Deflecting influences are those which unbalance the internal and external

pressure upon the growing dentures. Mouth breathing permits the jaw to hang suspended; the lips are open and relaxed, the tongue drops to the floor of the mouth and spreads out upon the occlusal surfaces of the lower teeth, lessening the pressure inside the dental arches. At the same time, the cheeks are more tightly drawn, increasing the external pressure upon the posterior segments of the arches. Narrow arches result, squeezing the anterior teeth forward into undue prominence, the more readily since the restraining pressure of closed lips is lacking.

Sucking habits also derange the normal pressures which guide the dentures and jaws to symmetrical growth. Tongue-sucking depresses both the upper and lower anterior teeth; lip-sucking protrudes the upper teeth and retrudes the lower ones. Thumb-sucking drags the entire upper arch forward and protrudes the upper anterior teeth on one side of the median line, the side upon which the thumb is sucked.

When the throat is crippled by unduly large adenoid growths, or excessive scar tissue resulting from their removal, the patient has difficulty in closing the posterior nares while swallowing; abnormal muscular effort forces the tongue between the anterior teeth, puckers the chin and contorts the lips. A malocclusion, one feature of which is an open bite in the anterior part of the dental arches, results, due to intrusion of the upper and lower teeth by tongue pressure. The same syndrome is established when adenoidectomy leaves in the throat an area of anesthesia, rendering the patient unable to tell when the posterior entrance to the nares is closed against food during deglutition. The prognosis for these cases is bad, unless the throat deformity can be corrected by plastic surgery.

A very common influence which deranges the normal pressure control of facial and denture growth is the extraneous pressures exerted in posture habits, such as sleeping on the lower half of the face.

The movable lower jaw gets out of the way of the pressure, but the upper jaw is narrowed, the palate is made higher on the crushed-in side, the teeth are forced out of line, or bunched, on the opposite side of the arch, and the nasal septum is deflected.[1]

If the child leans his face against his fist, the upper arch especially, and perhaps the lower also, will be constricted either unilaterally or bilaterally, with an anterior protrusion of the maxillary teeth. Often the entire denture will be found anterior to its correct position in relation to the malar process or key ridge.

Another deflecting influence is the directly upward pressure exerted when the child leans the lower border of the mandible or chin upon his fist. The posterior teeth are intruded or shortened, and there is an abnormally deep overbite, often accompanied by "buck" cuspids.

INHIBITING OR OBSTRUCTING INFLUENCES

Inhibiting or obstructing influences are those extraneous pressures resulting from leaning the weight of the head upon the point of the chin or sleeping with the weight upon the chin, so the pressure is toward the posterior part of the jaw. The maxillary denture is seldom found in retrusion, that is, posterior to its normal position under the malar process. The mandible itself, however, impeded by the retrusive pressure upon the chin, may lag considerably behind the upper jaw in development, with characteristic receding chin and "cow-catcher teeth." In such cases the upper denture may move forward normally, the maxillae developing forward with it; the lower denture, thanks to intercuspation with upper teeth, tends to be carried forward, at least part way, with the upper one, while the retrusive pressure upon the chin retards the growth of the mandible itself.

Glandular and nutritional factors loom large in all of these major malocclusions.

Under a given pressure, the amount of displacement of teeth will be proportionate to the amount of warping of the bone, and that will depend upon the softness of the bone. Bone softness reflects back directly to nutrition which provides the chemical elements, vitamin activators which catalyze their use and the endocrine balance which controls their distribution and elaboration. Another glandular influence is that of hyperpituitary activity. In this instance overdevelopment of both jaws, and particularly of the mandible, will produce spaces between the anterior teeth. Measurement from time to time will show the spaces to be enlarging in the active hyperpituitary case. Vast amounts of calcium and phosphorus are required to build the large bones of hyperpituitary giants; the bone may be poorly calcified, and the teeth may be subject to caries and to root resorption with or without the inciting influence of orthodontic treatment.

One may feel inclined to doubt that such seemingly trivial pressure as leaning on the face or chin could cause major malocclusion. The weight of the head approximates fifteen pounds; the patient who sleeps or leans upon his face throws that weight upon the facial bones many hours out of the twenty-four. If Aztecs could influence the growth of the hard dome of the skull by winding the head of the growing child with cloth tape, a custom still followed by some South Sea Island tribes, in order to produce a pointed skull, how much more easily can the facial bones be warped, honeycombed as they are by spaces for the roots of teeth and crypts in which permanent teeth are forming.

Observation will show many children, in school rooms and at home, and many adults in street cars and various other places, including pictures in the public press, leaning face or chin upon the hand. And almost always there will be found definite facial, dental and oral deformity, directly related to the location and direction of the pressure and depending in severity upon the hardness of the individual's bones.

INFLUENCES PERMITTING TOO EASY FORWARD MOVEMENT OF TEETH, UNACCOMPANIED BY NORMAL JAW GROWTH

The orbicularis oris muscle serves as a circular strap tied back, by corner straps, to the posterior portion of the face. Normally this muscle exerts pressure upon the anterior teeth, which pass it on down the line of the arch to the most posterior molar. If, through mouth-breathing, this pressure is lost, the entire denture may drift too far forward. The actual growth of the jaw is not augmented by such influences, but the denture is permitted to occupy too anterior a position in the jaw. The gage of denture orientation in the jaw is the position of the mesiobuccal root of the upper first permanent molar under the malar process at eighteen years of age, or behind it an appropriate distance at earlier ages. If orthodontic treatment should round out the teeth to arch form and alinement in the protruded denture position, there will be root resorptions, roots forced through the labial cortical plate of the jaw and inadequate periodontal support which will induce periodontosis in later life. In addition, the patient will have that "toothy" smile in which the teeth seem too large, too numerous or too prominent.

Another condition permitting too rapid or abnormal forward drift of teeth is the premature loss of a tooth during the developmental period. If a deciduous molar is lost, the posterior teeth drift rapidly forward into the space; when the permanent bicuspid attempts to erupt, there is no room for it, and bunched teeth in an underdeveloped jaw will result. When a first permanent molar is lost, the second and third will drift forward; and underdevelopment of the jaw will result, with malrelation between the cusps of upper and lower molars.

A shameful lapse of duty is chargeable

to almost the entire dental profession, in regard to arch vacancies during the period of the child's rapid growth. Probably less than 5 per cent of general practitioners have made space maintainers for such cases; and a shockingly small percentage use them habitually. Malocclusion, diminished masticatory function and periodontal disease in later life could all be prevented by the application of simple and inexpensive space maintainers to maintain arch dimension in premature extraction cases.

From all of the above, one readily visualizes a most important function of the general practitioner in the field of orthodontics, and an important preventive duty to his patients. It lies in keeping constant watch for: 1. Arch vacancies, due to extraction or to congenital absence of teeth, such as a lateral incisor, which permits the entire denture to drift forward too readily, without normal development of the anterior portion of the jaw. The patient has a typically flat appearance round the base of the nose, and the permanent teeth will erupt into major malocclusion. 2. Rotated or misplaced teeth which present a shortened mesiodistal dimension and thus permit too great forward movement of posterior teeth. 3. Major carious cavities which destroy anteroposterior tooth dimension, permitting too great forward drift of posterior teeth.

The general practitioner's orthodontic responsibility lies also in providing space maintainers at once, in all cases of premature extraction of deciduous teeth or first permanent molars. And it lies in watching all children for indications of leaning or sleeping posture habits which exert extraneous pressure upon the growing face and denture. It lies largely, too, in educating expectant mothers regarding the danger of placing infants upon their faces for sleep; in educating them, as well as the parents of growing children, teachers, school nurses and all physicians, against leaning and sleeping habits. Physicians, who see our patients years before we see them, could vastly diminish the incidence of malocclusion.

For the general practitioner of the rural community, who is obliged to undertake orthodontic cases, it is impossible to adequately cover the subject except by writing an entire text on orthodontics. Certain outstanding features relative to modern practice of orthodontics as a health service might be mentioned:

1. Simple labial arches, attached to molar teeth as anchorage for wire or grassline ligatures, offer inadequate control both of the anchor teeth, which are liable to be displaced, and of the ligatures, which are prone to cut the gingivae and deepen the gingival crevice. Beckwith[2] and others have shown the gum tissue to be infiltrated with bacteria in even simple gingivitis, and the general gingivitis which accompanies crude methods of orthodontic treatment is a present health menace to the child and a periodontal menace for his adult life.

2. Therapeutic force should be applied with full control, and an exceeding gentleness, in order that the cell changes induced may be as nearly physiologic in nature as possible; pathologic resorption of bone is not the goal, but, rather, stimulation of growth. This can best be accomplished by very small resilient wires, preferably of stainless steel, definitely locked into brackets on bands cemented to the teeth. In expert hands, the Universal appliance of Atkinson[1] offers, in the writer's opinion, the ultimate obtainable at the present time. It provides, in effect, a combination of the ribbon and edgewise arches, both operating upon the tooth through the medium of a single bracket. There is no occasion for gingivitis, deepening of the gingival crevice, or pathologic bone changes.

3. The dentures should always be correctly oriented, anteroposteriorly, in the skull. If one denture is in anterior protrusion, the posterior teeth should be moved back to their normal places before

expanding the anterior portion of the arch. Teeth should not be crowded into line by brute force; when the influence which forced them out of line is removed, and room is made for them, they will almost drop into place of their own accord.

4. The operator should make routine use of experimental models. These are duplicate models, mounted upon an articulator if the case requires it. Upon these models the teeth to be moved are cut free one by one, and placed in the desired positions. Often it will be found that the proposed plan is not feasible; the teeth may be too large or too small for the space obtainable. As far as possible, any experimenting should be done upon models rather than on patients. When actual treatment begins, the time spent on the experimental models is more than saved; and in addition, much humiliation for the operator and much dental misfortune for the patient may be saved in the bargain.

5. If the upper and lower dentures are both in anterior protrusion, the teeth should not be forced out into alinement where they will have inadequate support and a toothy appearance. It is advisable in such cases to remove four bicuspids and retrude the anterior teeth to more sound periodontal support. In cases of maxillary protrusion in adult patients, where the posterior teeth are in acceptable occlusion, it is often advisable to remove two upper bicuspids and retrude the maxillary anterior teeth, satisfying the esthetic requirements and perhaps overcoming a serious inferiority complex, with minimum damage to the dentures.

To all who undertake orthodontic treatment, whether general practitioners or specialists, a few factors of orthodontic health service might be stressed:

The term "malocclusion" does not refer to deranged esthetic factors but to occlusal deformity, which can only be defined as a malformation or malrelation of the teeth which prevents them from performing their masticatory function. In correcting malocclusion, then, the practitioner is primarily correcting the occlusal deformity and producing masticatory function. This, in the modern concept, means that teeth should be placed in coordinated or so-called "balanced" occlusion. Bilateral functional contacts must be accepted as the proper human tooth and cusp relationship, and all departments of dental practice should be predicated upon it.

To accomplish this tooth relationship calls for the mesiodistal uprighting of posterior teeth to form the mesiodistal or longitudinal occlusal curve (of Spee), and torquing them buccolingually to produce a lateral occlusal curve for each side of the arch. Only when placed in such axial angulations can posterior teeth have cuspal coordination throughout the various functional movements of the jaw.

The longitudinal curve (of Spee) embraces also the overbite of the anterior teeth, which should be in harmony with the posterior portion of the occlusal curve. A large percentage of orthodontic cases require correction of an extreme anterior overbite, by intrusion of anterior teeth and extrusion of posterior teeth. It is axiomatic that excessive overbite limits function and predisposes to periodontal disease of the anterior teeth.

We have long considered that the so-called "balancing" contacts of teeth were useful only on the inactive side of the arch, while the bolus is chewed on the active or working side, to balance artificial teeth against displacement, or help support the masticative pressure of the jaw. Exceptions are seen in the few cases of individuals who chew simultaneously upon both sides of the arch. The chewing set-up and movements of herbivorous animals were used as an argument that human beings chew on one side at a time and do not require bilateral or balancing cusp contacts.

As a matter of fact, omnivorous animals, notably the higher apes and man, do normally (which means not "usually" but ideally) have bilateral or balancing contacts, and the motion picture analysis shows that when individuals have occlusal coordination, or balanced natural dentures, they do most of their shearing of food on the so-called balancing cusps. They have a full jaw swing, in which the jaw drops open and swings to one side, closing so the buccal cusps of posterior teeth are in contact. During this closure, the bolus is crushed, the mandible being held in "unilateral" balance by contraction of the opening and closing muscles, the closing muscles contracting and the "opening" muscles relaxing or "slacking off" so the jaw is under perfect control and can exert tremendous force without damage to teeth or periodontium. Once the buccal cusps meet through the bolus, in edge to edge contact, the jaw moves over toward the centric position. When centric relationship is reached, the patient who has no so-called "balancing" contacts, is through. He drops his jaw open and returns to the original position for another short crushing and shearing stroke.

The patient who has "balancing" contacts, however, moves on past centric position and shears food throughout the length of the upper lingual cusps. In fact he tends to close almost in centric position and to do most of his shearing on the lingual cusps, where he is riding up grade and can exert more effective cutting force. The upper molars are braced against such force, by their large lingual roots, and the lower molars by the I-beam shape and the curvature of their roots and by the heavy buccal cortical plate of the jaw.

The motion picture analysis also shows that teeth in wrong axial inclination, dentures with deep overbites and dentures which have cuspal interference, not only induce periodontosis in the conflicting teeth, but that such patients use in chewing a short "chop stroke" which jars the entire periodontium. The smooth swing of "balanced" dentures is kind to their periodontium. The jaw glides down the buccal cusps of the upper teeth to a "zooming" landing in centric position, with the bolus of food trapped in the upper and lower sulci to serve as a shock breaker. As the shearing stroke continues beyond centric position, the biting force is gradually increased as the lower teeth ride up the lingual cusps of the upper ones.

Unbalanced occlusion therefore means only half a shearing stroke; utilization of less than half of the occlusal surfaces of the teeth, and greater shock and stress to the periodontium.

To obtain occlusal coordination during orthodontic treatment is a difficult matter. The orthodontist of today will make a point of knowing as much about synthesizing an occlusion as the prosthodontist does, and in addition will study his active cases, each time the patient calls for adjustment, not only in centric or static intercuspation, but also in the dynamic relationships occurring during the right and left lateral and protrusive movements of the jaw. A case brought to approximate coordination will "settle" to even better relationships during the periods of maintenance and postmaintenance.

In most orthodontic cases, however, it will be found that anomalies of tooth size, common in malocclusion patients, or the dimensional limitations of the case, and perhaps the present shortcomings of orthodontic technic, will usually make necessary a reasonable amount of "selective spot-grinding." After orthodontic means has accomplished its utmost, spot-grinding, within proper limits, becomes good practice during and at the end of the period of maintenance. This does not mean carbon marking the conflicting cusps and cutting off the marks with large wheel stones. It means careful study of the carbon marks and removal of selected portions of the corresponding upper and

lower marks with small carborundum points, in such a way that nothing is removed to accommodate one jaw position that will be needed to make the necessary functional contacts in another jaw relationship. Particularly, it is always necessary to maintain the integrity of centric occlusal contacts.

In orthodontics as in every other department of dental practice, it is not sufficient for a man to do his best. He must, in addition, make sure that his best is the best obtainable "best," in the existing status of dental knowledge.

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EFFECTS OF CERTAIN HORMONES ON GINGIVAL AND ORAL MUCOUS MEMBRANES

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THE influence of endocrine imbalance has been the subject of numerous studies during recent years. The complexity of such research can readily be seen when it is understood that, according to our best knowledge, each gland secretes one or more hormones, which, in themselves, not only exert an action on the chemical and physiologic processes of the body, but may also increase and otherwise affect the action of other ductless glands.

While it is generally believed that a hormone does not directly influence the endocrine gland from which it originates, its active principle, in modifying the function of other glands, may indirectly affect the source; i.e., the follicular hormone of the ovary, which stimulates the secondary sex organs, has no apparent action on the ovary itself. However, it does excite the anterior lobe of the pituitary to the secretion of a gonadotropic hormone, which, in turn, has some function in activating the secretion of the follicular hormone. Thus a balanced cycle is maintained.

When there is an insufficiency of a glandular secretion or when a gland is absent, the secretion of that gland may be supplemented. This is known as substitution or replacement therapy. Unfortunately, no cure is achieved, and treatment must be continuous as long as the need exists. The use of insulin in combating diabetes mellitus is an illustration of replacement therapy. More effective therapeutic measures in the case of underfunctioning glands seem to point in the direction of stimulation rather than substitution, although endocrinology has not yet advanced to the stage where this therapy is applied with general success.

Numerous diseases have been attributed to an overfunctioning or an under-

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functioning glandular system, and some of these are manifest in the oral tissues. Of the more common affections of the gums which may be traced directly to the endocrines is so-called "pregnancy gingivitis." Blackberg and I, in studying a group of 416 pregnant women, reported (in 1933) its occurrence in some form in more than 70 per cent of the cases. Since then, on the basis of additional data, we are of the opinion that the percentage is even greater.

"Pregnancy gingivitis" may assume five distinct forms, more than one usually appearing in each case.

The first form, and by far the most common, is characterized by bleeding of the gums. On questioning the patient, it may be ascertained that the tendency for the gums to bleed when traumatized by the toothbrush, food, etc., developed after the onset of pregnancy; or, if the symptom were present before pregnancy, it became exaggerated after conception. Hemorrhage is also easily induced by probing.

The next recognizable form is a slight change in the interdental papillae. The papilla loses its stippled appearance, becoming glossy or "glassy" looking. Its color changes from pink to old rose. There is some edema, creating a mildly puffed appearance. Because of the swelling, the papilla no longer maintains the sharply pointed architecture of a pyramid, but becomes somewhat blunted at the tip. The symptoms are seen early, and if uncomplicated by local conditions, may persist in an unexaggerated state throughout the term. After parturition, the gums generally return to normal without treatment. It should be pointed out here that the changes just described may be so slight as to be easily overlooked unless careful examination is made. On the other hand, they may be gross enough to be readily discernible.

In the third type of "pregnancy gingivitis," usually only the free gum margin is involved. It takes on the color and appearance of a raspberry. The highly inflamed tissue bleeds easily on being probed. Its most frequent site is the anterior gums, although it may be found in other locations. This form is designated "raspberry red gums."

The fourth form, a generalized hypertrophy of the tissue, is designated "hypertrophic gingivitis of pregnancy." The interdental papillae become noticeably enlarged, losing their natural contours. The color may vary from an old rose to a deeper, cyanotic hue. In the presence of irritation, the borders may become bright red. The amount of involvement varies. One, a few or many papillae may be involved in one or more sections of the mouth. The tumefaction of the individual papillae is gross in some and slight in others.

The enlargement of the papillae is due in part to edema, but also to hyperplasia of the epithelium. Sometimes, a proliferation tissue forms. As it grows, the normal gum is pushed back, a straight blanched line of demarcation resulting. In some instances, the proliferation tissue, which emerges from the under surface of the papillae, may grow over and cover in part the crown portion of the teeth. Here, then, is created a favorable site for mouth sordes to collect and act as an irritant, additional proliferation resulting. Other traumatic conditions, such as food impactions, the presence of calculus, overhanging margins of previously placed prostheses or sharp margins of cavities and lack of function in a small area further complicate the pathologic process. However, sometimes no irritants whatever are apparent.

In a few cases that I have observed, several of the interdental papillae had grown to such proportions that they took on the appearance of epulides. As the individual papillae spread laterally, the attachment to the gingivae became narrowed, giving the appearance of a pedunculated base. But even in this distorted stage, they must still be classed as indica-

tive of hypertrophic gingivitis, since they respond to treatment for this group rather than for epulis.

In other cases, the proliferation started from the under surface of the free gum margin and spread along the sulcus, covering the tooth for a few millimeters without involvement of the interdental papilla.

Another type of change in the same category, which occurs less frequently, is the formation of a pseudopapilla. Here, the interdental papilla may not be enlarged, and the pseudopapilla may be the same color as the rest of the gingivae. However, a definite horizontal line of separation, forming a cleft, can be seen at the base of the papilla. If a flat blunt blade is placed in this line, it is a simple procedure to lift the growth from the normal gum and, with little effort, it can be removed.

In all instances of "hypertrophic gingivitis of pregnancy," the gums bleed easily on being probed, but are seldom, if ever, painful.

The fifth form of "pregnancy gingivitis" is the so-called pregnancy tumor, for the most part confined to a single growth springing up at any point in the mouth. At the outset, it appears to be an overgrown gum papilla. After it has attained considerable size, it resembles an epulis varying from 1 to 2 cm. in diameter, and sometimes larger. It usually has a pedunculated attachment. In color, it is cyanotic, with a bright red border. Often, it interferes with mastication, and the trauma to which it is subjected produces an area of grayish necrosis on parts of the surface. However, in one case studied, the entire growth was blood red. Here also, gingival irritants may be present. The tumor may begin early in pregnancy, and usually grows rapidly and bleeds readily. It differs from the ordinary epulis in that it may either disappear entirely or diminish greatly in size after parturition. While the "pregnancy tumor" is identified with the pregnant state, a true epulis may be coexistent. The epulis may likewise grow with pregnancy and diminish with parturition, but it has other distinguishing characteristics and should not be confused with the condition known as "pregnancy tumor."

All forms of "pregnancy gingivitis," if not properly treated, are likely to recur with subsequent pregnancies, or set up some other form of gingivitis after parturition. Moreover, "pregnancy gingivitis" may or may not be accompanied by a Vincent's infection, periodontoclasia or the presence of fungi and bacteria in the tissue.

Treatment consists of frequent prophylaxis, thorough scaling of the teeth and gingival curettage. The purpose of the curettage is gently to produce hemorrhage from the enlarged papillae, which, after they have bled, are reduced in size. Thereafter, the interdental method of toothbrushing can be effectively applied. Frequent inspection of the gums is essential in order that existing pathosis may be detected and treated early and prophylactic measures be instituted.

In attempting to define the etiology of "pregnancy gingivitis," a few observers have speculated on a possible endocrine connection. Because of alteration of hormonal secretions during pregnancy and the gingival changes already described as occurring at this time, my own research has concerned itself with this hypothesis. Further impetus for study in this direction has been provided by the following findings:

Changes described as pregnancy gingivitis are not limited to pregnant women. They occur in non-pregnant women, in men, very frequently in boys and girls at about the time of puberty and in women during the menstrual period. However, their most frequent occurrence is at times usually associated with hormonal changes—pregnancy, menstruation and puberty.

In order to better comprehend the possible relationship between glandular function and alterations occurring in the

gingivae, some pertinent facts elicited as a result of our investigations are here cited.

Our studies included the use of both estrogenic and gonadotropic hormones, which were injected into normal and castrated female rhesus monkeys. A group of women receiving these hormones in the treatment of gynecologic disorders were also studied.

In the estrogenic series, the preparations used were: 1. Estradial=dihydrytheelin. 2. Estrone=theelin. 3. Estriol =theelol.

The diversity of trade names employed by manufacturers to designate these products has led to considerable confusion. Therefore, the Council of Pharmacy and Chemistry of the American Medical Association has recently (1936) recommended the foregoing classification. While the properties of the three are not identical, their influence on the secondary sex organs is similar. When injected into monkeys or women in large enough quantities, their action on the gums is the same. This action is to produce:

1. Hyperkeratinization. Where keratin is found normally, namely on the surface of the alveolar gingivae, this layer was improved. Keratin was also seen on the surface of the areolar gingivae and the oral mucous membranes, areas where none is found normally. In addition, epithelial pearls appeared in the prickle cell layer; which is a further sign of hyperkeratinization. 2. Hyperplasia of the prickle-cell layer of the epithelium. Inflammatory reactions in the subepithelial layer were either reduced to a minimum or entirely absent.

From the foregoing, we were led to assume that the use of this hormone had a beneficial effect on the gums and oral mucous membranes.

The gonadotropic series and its action follows:

1. From the urine of castrated women. When injected into the normal female monkeys, the action on the gums and oral mucous membranes was similar to that of the estrogenic hormones.

2. From pyridine extracts of the anterior pituitary gland. Again, our findings in normal female monkeys coincided with the estrogenic experiments.

3. From an extract of pregnancy urine (prolan). Here, the effect was entirely different. When injected in normal female monkeys or women with dysmenorrhea, the changes occurring in the gums were of a degenerative nature.

In the monkeys, the gross findings resembled those seen in pregnancy gingivitis. The interdental papillae became markedly enlarged and were an old rose. Bleeding was easily induced and in some spontaneous hemorrhage was seen.

In the human group, the gums became inflamed and the interdental papillae edematous and prone to bleeding. More extreme reactions were observed in certain cases which took on the appearance of "subacute Vincent's infection," and, in one instance, an acute Vincent's infection developed. The gum involvement persisted throughout the treatment period. As a series, the women receiving prolan showed gingival changes strikingly opposed to those found in the estrogenic group.

Moreover, our experiments with prolan in castrated female monkeys revealed even more drastic degeneration of the gums. Acute Vincent's infection was found grossly and confirmed bacteriologically. Microscopically, examination disclosed reduction in surface keratin and cellular deterioration with slight hypoplasia of the prickle-cell layer. In the subepithelial layer, evidences of inflammatory reaction were generally seen.

Having progressed thus far in our experimentation, the next step for us to consider is therapeutic practicability. It has been seen that the estrogenic hormones and their stimulators have an apparent beneficial effect on the gums. Consequently, as was indicated earlier in this discussion, employment of the stimu-

lators would seem to be a logical procedure. However, this method must, at the present time, be ruled out because (1) the hormones in question are as yet not available in commercial preparations of sufficient refinement and (2) their effect on other glands and tissues of the body would constitute a pertinent factor.

At the moment, then, therapeutic activities must be limited to commercial preparations of the estrogenic hormone, although here too certain disadvantages present themselves. For one, in treating with these substances, we are in a sense resorting to the only partially satisfactory method of substitution therapy, inasmuch as the hormone is effective chiefly while in use. Secondly, the problem of dosage has yet to be disposed of. I am now studying the question from the standpoint of dosage in relation to type of case.

Then again, a distinct point in favor of the estrogenic hormone is its seeming harmlessness. Large quantities have been given to women over comparatively long periods of time without any noticeable deleterious results. I have examined the gums of a number of women receiving this treatment in Dr. Raphael Kurzrok's clinic for gynecologic diseases, and have also injected the hormone in cases that were normal from the gynecologic standpoint. No injurious effects were seen. Hence, in cases offering no contraindications, we have encountered no hazard in the use of the estrogenic hormone.

The effect to be expected from these injections at the present time is that of a beneficial adjunct to local treatment. Such systemic therapy will not, I believe, replace local therapy. It will accelerate or augment it.

From the studies here briefly outlined and others, we must conclude that the oral tissues as a whole are influenced by endocrine imbalance, as are tissues and organs in other parts of the body; and, furthermore, that hormonal secretions are a potent factor in the etiology of certain gingival diseases.

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VINCENT'S INFECTION

By S. R. PARKS, D.D.S., Dallas, Texas

EVERY year or so, a paper on Vincent's infection is read before the American Dental Association. These papers have exhausted somewhat the theories as to cause and treatment of this devastating and destructive disease, but new theories are constantly appearing. Bacteriologically, we know little about the condition.

I shall deal here with the practical procedure in the handling of Vincent's infection by the rank and file of general practitioners of dentistry.

Before proceeding, it will be necessary to classify the disease. As in teaching and in office practice, I here make free use of the Arthur H. Merritt classification: (1) gingival recession; (2) gingivitis; (3) Vincent's infection, and (4) periodontoclasia.

Let us consider a diagnosis of Vincent's infection as differentiated from the other three forms of periodontoclasia. This condition presents two or three symptoms which are characteristic of it but which are seldom seen in the other three forms. They are (1) sudden onset, (2) pain and, later (3) grayish white ulcers. It is true that both syphilitic and diphtheritic ulcers are often seen in the mouth, but these are easily differentiated from the ulcers of Vincent's.

It is true that bleeding and some of the other commonly observed symptoms may be noted, but bleeding is always present in gingivitis, and sometimes in gingival recession, and often is present in periodontoclasia. It follows, then, that hemorrhage is not necessarily a symptom of very great diagnostic value. Having disposed of that symptom, let us consider for a moment the value of the microscope in diagnosis. For a number of years, certain essayists have claimed that a positive diagnosis could be made by finding both organisms, the fusiform bacillus and the spirillum, microscopically. It has further been asserted that after proper treatment, no organisms could be found and that the case could therefore be dismissed as cured. In 1926, the American Dental Association decided to spend some time and money on research in this field and was fortunate in securing the services of a practical scientist, Theodore Beust, of the University of Louisville. The results of his findings ten years ago still stand and may be proved by any dentist in five minutes. They may be summed up with reference to microscopic diagnosis in one sentence: With a proper microscopic technic, any normal mouth may be found to be affected with Vincent's infection if the presence of the fusiform bacillus and the spirillum in numbers is the differentiating factor, for they can be found in sufficient quantities in any normal mouth.

I have confirmed Beust's findings many times. To prove the point further: Have you any record of ever having made or seen a laboratory report marked suspected Vincent's infection and received a report back other than positive for Vincent's infection?

Now let us consider the type of patient who has Vincent's infection. Although the condition may sometimes be seen in

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mouths that apparently are clean, it is most often observed in mouths that are filthy or that are suffering from mechanical or chemical injuries. Under chemical injuries, we have listed for a long time the effects of taking alcohol in any form and of smoking or chewing tobacco. I wish to list one other chemical source of injury which has not hitherto been recorded. It is the constant use, many times a day, of carbonated soft drinks, which are sold all over the United States, but in much larger quantities in the South. These drinks, because of the carbonated water in them, will cause a chemical burn of the mucous membrane of the mouth and lower the resistance to such a point that invasion by organisms is a natural sequence.

Pain and sudden onset are not often seen in the other three forms of periodontoclasia. It is not necessary to consider here the following additional symptoms: temperature, malaise, metallic odor, loss of appetite, loss of sleep, uneasiness, etc.

Let us suppose that a case has been diagnosed as Vincent's infection. This diagnosis has been arrived at by observation of clinical symptoms only, as may be done in any case of Vincent's infection. Suppose for the sake of discussion that the patient decides not to have any treatment whatever: What, then, will happen? One of three things: 1. The patient will get well because of a high resistance. 2. He will die because of a septicemia. 3. He will neither get well nor die, but will develop a stubborn case of Vincent's infection superimposed upon a well-advanced case of periodontoclasia, thereby acting as a carrier to other persons and as a menace to health. This is the usual picture of a non-treated case. Is it not probable that in many of the new cases and also in some of the endemic areas, the source of the infection is the patient last mentioned?

Now let us suppose that the patient seeks treatment. What shall we do first? The answer depends on one fact. Does he or does he not have pain? If he has pain, let us apply our favorite treatment. It must, of necessity, be some medicine applied locally which will destroy the organisms. Both oxidizing agents and acids may be used. When the patient presents a mouth free of pain, the operator should begin instrumentation; that is, careful subgingival curettage. There should be no fear of removing the deposits, for thereby a blood-letting and cleansing procedure is carried out at the same time. More cases of Vincent's infection have been caused by using medicines only and dismissing the cases as cured when they are not than in any other way.

In treating with medicines only, we have been aided and abetted by our friends the oral surgeons and exodontists, whose eye focus does not narrow to any finer point than a tooth root. Deposits are rather small for their armamentarium. Then, too, physicians who use the various intravenous injections without the necessary intra-oral cleansing are perhaps guilty, innocently, of creating cases of Vincent's carriers. Some cases may respond to medicinal treatment only, but the majority will respond much more quickly if medicinal measures and subgingival curettage are carried out simultaneously. Every case must have a thorough prophylactic treatment before it is dismissed, or else the organisms will lurk beyond the deposits and renew their activities.

Chromic acid, from 5 per cent to crystal form, is very efficacious. Silver nitrate and tricloracetic acid may be used effectively. Chromic acid has two disadvantages: bad taste and staining tendencies. The use of hydrogen peroxide will give excellent results. I rely largely on these two, applied both locally and as mouth washes. Sodium perborate does not give off enough oxygen to compensate for the time required in using it. The same result can be obtained in less time by using

medicines with a stronger oxygen content or your favorite acid. The organisms will not live for any appreciable length of time in the presence of free oxygen. It has been supposed, however, in obstinate cases, that they build up an immunity to certain strengths of oxygen or acids, which makes it necessary to change the treatment slightly. This is probably not true. The filth probably has not been removed.

Very few cases of Vincent's infection are uncomplicated. Nearly all mouths which become involved either have or will develop some other form of periodontoclasia. This is a partial explanation of what is commonly called chronic Vincent's infection. The procedure here is to make the "Vincent's plus" diagnosis, and then treat the two, the Vincent's and the other condition, which, in most instances, will be an advanced form of periodontoclasia.

It therefore falls to our lot as dentists to acquaint ourselves more and more with the diagnosis and treatment of all the forms of periodontoclasia. Just to treat the part and not the whole is a poor effort toward the alleviation of the results of this disease, for its final result is more far reaching than its superficial clinical symptoms indicate. Every time we treat one case successfully, we not only render that patient a fine service, but also make a distinct contribution to the health of the nation by reducing the carrier percentage.

Medical Arts Building.

THE IMPROVED STATUS OF THE PULPLESS TOOTH

By Harry B. Johnston, D.D.S., Atlanta, Ga.

The most important single thing in preventive medicine today is oral hygiene and the preservation of the teeth.—Sir William Osler.

THE man who contends that all pulpless teeth should be extracted and he who says that none should be are merely on opposite ends of the same plank. The balance point lies about midway between them. Either extreme position is unreasonable, illogical and unethical. Therefore, both are unscientific and entirely untenable.

The memorable words of Hunter have constituted a battle cry which has rallied a very considerable portion of the dental and medical profession against the pulpless tooth as a deadly menace to the health and even the life of the patient. The words of Osler, quoted above, are of equal significance, and if quoted at the same time, would tend to stabilize and rationalize our thinking and action.

From an early period, surgery has passed through a succession of amputation or elimination fads. It passed through the radical periods of ovariectomy, appendectomy and tonsillectomy. Dentistry, following suit, is now passing through the medically conceived and fostered period of exodontia. In their early days, all of these fads were carried to excess, but after several years of observation and reflection, radicalism has always been abandoned and the operation in question brought to a high degree of usefulness. It is encouraging to note that the fad of radical exodontia is distinctly losing its momen-

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tum and probably will soon be given its proper place in dentistry. For many years, we have been in this orgy of extraction. Now, however, we are in the beginning of a period of real understanding of the physiologic and pathologic significance of teeth, as is evidenced by the protests arising from unbiased members of both professions.

One would reasonably expect to find dentists on the side of conservation of those organs which are their exclusive care. This is true, I think, with a great majority in the profession, but the very articulate minority are responsible for a wrong conception as to the attitude of the profession as a whole toward the question of extraction. It is true, however, that a considerable number of both the medical and dental professions apparently fail to realize that the teeth are essentially organs of digestion, that they alone prepare the material which is to be acted on by the alimentary fluids and by them converted into food. Digestion is a mechanicochemical process. To neglect the mechanical part is to fail, to a greater or less extent, in the chemical part.

One cannot admire the stand of many of the leaders in our profession who, immediately on the pronouncement of this theory of focal infection, threw up their hands in abject surrender and, entirely without protest or question, launched a campaign for the elimination of every suspected tooth. This is just the reverse of the position that every dentist who gives consideration to the welfare of his patient should take. The late beloved Edmund Kells said that every dentist should do his utmost to place all diseased teeth in a healthy condition, and not until he had made such an effort and failed should extraction be considered. This is so evidently sane as to pass without comment. Findley,[1] several years ago, treated the subject somewhat differently by crying out that the old surgical axiom "save what can be saved" had given way to that of "destroy to the uttermost."

It must be said in extenuation, however, that there were many physiologic factors favoring the acceptance of extraction as the solution of all apical and gingival infection problems. Ten years ago, Hatton[2] made the statement that no recent contribution had done more to dignify the position of the dentist than the theory of focal infection. In it, many dentists saw a vehicle upon which they could ride into full professional equality with physicians. The words of Osler far surpass in their dignifying effect the focal infection claim of Hunter, but their observance lacked the element of the spectacular which was one of the strong appeals of Hunter's claim. Hatton[3] put these on about the lowest plane when he states that his observation has been that many of the men who are enthusiastic devotees of the theory of focal infection are either laboratory experimenters or men who profit largely by the application of the theory.

The popularity of the theory is attested to by Prime,[4] who calls attention to the fact that the largest crowds at the clinics will be found in the room where the methods for removing teeth and replacing them with bridges and artificial dentures are shown. He says further that if the clinic advocates a simple method of saving teeth, those present may total a baker's dozen: the crowd will be in the room where they are extracting teeth. The crowd and the interest, he says, will vary directly with the remoteness of the subject from saving teeth. This seems pessimistic, but it is merely realistic.

Grossman[5] warns us that the practices of the past can be condoned because of a lack of bacteriologic knowledge, but that those of the present and future cannot be, because that knowledge is now available. He also makes the encouraging observation that the extraction orgy which followed Hunter's declaration has long since been deprecated even by the most ardent advocates of the focal infection theory. In this, I fear, the wish is father to the

thought. Hunter would probably have been the last to advocate ruthless destruction of the dental mechanism. It would be more logical to expect from one of his balance conservative and constructive methods for removing real or potential foci. The true practitioner of the healing art considers the immediate and ultimate welfare of his patient first, and therapeutic measures second.

No criticism may be made of Hunter for his pronouncement. The potential menace of foci of infection was recognized long before he voiced it. It was true to a definite extent then; it is true to the same extent now. The harm came from the fact that so many failed to make correct general and clinical interpretation of Hunter's statement. Radical surgery, while it has been tried in many therapeutic endeavors, has found only one proper field, the elimination of malignancy. If we are to accept the lead of medicine, let us imitate its virtues as well as its shortcomings, and incidentally follow those who will lead us "beside the still waters" of constructive, conservative accomplishment.

Grove[6] stimulates those who wish to create instead of destroy when he says that the existing situation is an admission that the profession acknowledges itself to be unequal to the problem of the healthful retention of the pulpless tooth. Medicine has ever been willing to explore the realm of the impossible, as is so well illustrated in the conquering of yellow fever, malaria, tuberculosis and many other diseases. Are we willing to admit that we are in hopeless defeat by a problem as circumscribed and simple as the retention of the few organs under our care?

Findley[1] gives us encouragement in a statement to the effect that, when dentistry has attained maturity in years and experience, conservatism will be enthroned to the everlasting benefit of society.

There are few who believe that oral foci of infection are incapable of harm to other parts of the body. On the other hand, this is quite generally admitted, though many claim that the harm is rarely more than local. Probably no one would say that mouth infection of any sort should be permitted to continue beyond the earliest possible moment of its correction, but the ranks of those who advocate wholesale extraction and even the cutting away of large sections of alveolar bone are rapidly thinning.

Potts[7] makes the significant observation that although more diseases are manifested in the mouth than in any other part of the body, the mouth is not the source of all the ills from which the other regions of the body suffer. The importance of the mouth as a pathologic index to the eye of the trained observer is admitted; for example, in the early indication of measles, but no one has yet claimed that measles originates in the mouth. Solis-Cohen[8] states that, in the presence of disease, due probably to focal infection, it is best to remove a tooth that is known to be abscessed; but he somewhat confusingly adds that he is by no means convinced that this will continue to be the practice of the future. That is quite conservative and is probably very near the truth as it will be known when the "maturity" spoken of by Findley is attained. According to Joseph L. Miller,[16] however, it has not been proved that dental abscesses are responsible for systemic diseases and such proof must be furnished by clinical evidence and not by animal experimentation.

In entering on a study of observations relative to the pathogenicity of oral foci, it might be well to define the term. Steadman[9] definies it as "an infection confined ordinarily to a distinct location." This seems a clarifying definition; for it is immediately apparent that an encysted colony of bacteria, or one against which adequate local resistance has been established, cannot be regarded as in that state harmful to the host. The common dental

granuloma would naturally fall into this class, yet this is the phenomenon regarding which most of the fears of the focal infection theorists are expressed.

Buckley[10] makes the significant statement that unless germs grow, multiply and exert some deleterious action on their host, their presence is without any special significance. It is true that cyst walls can be broken and granulomata can become virulent, but with proper, adequate and timely treatment, there should be neither of these sequelae. Solis-Cohen[11] says that many physicians and dentists make the common mistake of taking it for granted that germs present in or on the tissues are necessarily infecting the patient, and that the members of these professions fail to make proper distinction between bacterial invasion or infestation and bacterial infection. Probably the majority of dentists, and certainly many physicians, believe that the presence of any bacteria in any tissues indicates an infective process. A classic example of this occurred when a physician of national prominence exhibited a photomicrograph of a section of tissue showing a single coccus as evidence of infection.

Krimsky[12] goes even further in his statement to the effect that of all the primary foci of infection in the human body, the tooth is the one organ in which a special primary focus is rarely demonstrated. A large percentage of the proponents of the focal infection theory do not think it is necessary to demonstrate the focus, but merely to suspect its presence. This group is chided by Elliott[13] with the admonition that presumptive, but not demonstrated oral infection should receive conservative consideration; but those who do not understand the art of conservative consideration continue to call on the exodontist to substitute his skill for their lack of it. It is true that this effectively closes the case for the operator, but, unfortunately, not for the patient.

Puterbaugh[14] very clearly deals with this phase of the question when he remarks that the elimination of all suspected dental foci in patients with ill health and broken resistance is the duty of every dentist. On the other hand, he states that the tactics of certain members of the self-styled 100 per cent group, whose methods savor of the careless rather than of the thoughtful, conscientious student of pathology, should be most vigorously condemned. On the same subject, Hatton[2] makes the important observation that while we realize the potential menace of mouth infection, we should discount the part played by it in the production of foci elsewhere in the body, or in the production of degenerative diseases of the latter decades of life. When we consider the staggering number of weakened, elderly patients who have been rendered edentulous and compelled to spend their few remaining years in the nerve-racking and hopeless effort to learn to manipulate artificial dentures, with consequent lack of appetite and impaired digestion, we begin to realize the great damage done and the number of years wasted by these enthusiastic but thoughtless operators, possibly entirely because of the presence of small Heberden's nodes at the phalangeal articulations.

So much has been loudly said of the potential menace of periapical foci, demonstrable or otherwise, that one is impressed with the number of authorities who dissent on this subject. Ziskin[15] states that, in spite of an exhaustive study of more than a thousand cases, he failed to find that a person with one or more pulpless teeth is more liable to contract a degenerative disease than one with no pulpless teeth. This finding is significant, and the number of cases is sufficient to be arresting. According to Joseph L. Miller,[16] Schottmüller, the German authority on sepsis, states positively that chronic root infections are innocuous. This is the most radical statement that I have been able to find on the conservative side. Haden[17] warns us that demonstration of the relationship of dental infection to systemic

disease does not prove, or even necessarily imply, that elimination of the infection will cure the disease. The weight of evidence rests with the proponents of the focal infection theory, and until they can disprove such evidence as the foregoing, their case has certainly no better standing than that of their opponents.

Krimsky[12] states that *Streptococcus viridans,* in a strictly focal infection of the teeth, is comparatively harmless.

Hatton[2] reminds us that there are two phases of the incidence of mouth infection that are given but little attention: 1. Mouth infection is an index to the individual's reaction to infection and parallels degenerative conditions elsewhere in the body rather than precedes them. 2. Mouth infection may be, and often is, secondary to chronic infection elsewhere in the body.

This is a view of the theory of focal infection from an angle opposite to the one now popular, and is supported by much logical deduction as well as clinical observation.

Arnett and Ennis[18] present a somewhat different point of view, as well as a different phase of the question, by stating that it is now regarded as established that non-hemolytic streptococci are to be found in saliva and about the teeth of normal persons throughout life; that non-hemolytic streptococci can usually be cultivated in the roots of pulpless teeth and occasionally from these sites in vital and apparently sound teeth, and that the so-called granuloma usually yields cultures of non-hemolytic streptococci, though many are found to be sterile.

The non-hemolytic streptococcus is therefore considered to be a common inhabitant of the mouth, both in health and in disease, and, for that reason, the demonstration of an organism of this group in the dental lesions of patients suffering from arthritis should not be given too great emphasis.

In their excellent paper, Arnett and Ennis[18] also deal with the careful medical and dental examinations of 883 students with special reference to the incidence and coincidence of dental and systemic diseases. Their conclusion, as expressed in their summary, is that "no statistically significant association could be demonstrated" between the so-called granuloma and underweight, albuminuria, rheumatism, chorea or heart disease.

Solis-Cohen[11] expresses a similar view, stating that bacteria are constantly being brought to the periapical tissues of teeth with living pulps and of pulpless teeth, and that to regard vital, sound and x-ray-negative teeth as infected merely because micro-organisms have been cultivated from them seems to be both unscientific and unwarranted. He also reiterates the well-known fact that regardless of the pathogenicity of such organisms for either human beings or laboratory animals, they cannot, unless they are pathogenic for their host, infect him. This truth is totally overlooked by so-called "100 per centers," and those who are determined, regardless of sense and science, to prove, at least to themselves, that the great majority of human ills originate in infected root canals or pulps.

Lintz[19] is in accord with the statement that not all periapical abscesses (granulomata) are infected, but an unstated percentage are absolutely sterile. He also supports the theory of a lowered, or a total absence of, pathogenicity of circumscribed colonies by the statement that where this area is sharply demarcated by a well-defined surrounding membrane, as evidenced in the roentgenogram, they have slight, if any, infective power.

Black,[20] in discussing Hatton's paper, makes the following significant observation:

> It would seem to be within the range of possibilities that the infected areas about the teeth might not be the cause of the so-called secondary lesions, but that the mouth areas might have been secondarily infected from the lesions elsewhere in the body. If this is so, in any given case the mouth lesion would

contain the particular strain of streptococcus which had developed in the gallbladder, stomach, ulcer or joint, and animals injected with cultures from the mouth areas would be likely to show a high percentage of involvement of gallbladder, stomach or joints, corresponding to the lesions of the patients from whose mouths the cultures were made.

This is a clear, concise, logical statement, the inescapable conclusions of which lead directly to the thesis that bacteria cannot have developed an "elective localization" for an organ or tissue in which they have never grown. Therefore, "elective localization" is *prima facie* evidence of their origin within the tissue for which they have this affinity.

The simplest logic will clearly indicate that if inoculation of a culture from the pulpless tooth of a patient afflicted with arthritis produces, in the experimental animal, a similar lesion, the apical infection was secondary and not primary.

Solis-Cohen[11] makes the same point in a statement of his belief that pulpless teeth often become infected from a body focus. He states that this belief is based upon both clinical experience and bacteriologic studies, and that this occurs much more often than is generally recognized. He states his belief that from simultaneous cultures of the different foci in the same patient, much of the dental infection with *Streptococcus viridans,* the non-hemolytic streptococcus, *Staphylococcus aureus,* and *Staphylococcus albus* are often secondary to infection in the upper air passages; *Streptococcus viridans* infection generally being secondary to a focus in the nasopharynx, and the non-hemolytic streptococcus infection to a primary infection in the throat or nasopharynx.

Potts[7] seems in full accord with the belief that many apical infections are secondary and receive their bacteria from the joints or other primary foci, thus becoming the offended instead of the offender. He also calls attention to the much neglected field of intestinal absorption, or invasion, by reminding us of the vast numbers of these most common bacteria that are swallowed and not destroyed by the hydrochloric acid in the stomach. Their toxic products are absorbed freely and, of course, any lesion affords entrance for the bacteria.

Many writers on the subject of apical infection contend that a large number of infected teeth present no discoverable evidence of infection other than that of the test tube. This has been called "symptomless disease," an apparently meaningless phrase. If these apices actually harbor bacteria, but give no symptoms, they are not pathogenic for their host. Many similar conditions in other parts of the body are well recognized by physicians and are given no treatment beyond simple hygienic care. Many of the radicals, without any attempt to justify the position, declare the small non-virulent area the primary and the larger, more virulent area the secondary; a postulate of the most empirical type. The same physicians, and many members of our profession, would completely destroy the masticating mechanism of the patient without any scientific proof or basis for suspicion that actual harm is coming therefrom. There are those who attempt to justify their technic and results in taking cultures and obtaining growth from extracted teeth by stating that these teeth presented no evidence, roentgenographic or otherwise, of pathosis. This is stressed in many papers, but probably most clinicians attach little importance to it because if any but the most incipient disease is present, but not discoverable by the roentgenogram, it is discoverable by other means.

Krimsky[12] calls attention to this point by stating that some of the most virulent cases of infection involve x-ray-negative teeth, but that there are always other symptoms which indicate the disease process. The clinician well knows that the acute periapical abscess, in its most violent stage, does not necessarily indicate a pathologic condition on the roentgeno-

gram. Furthermore, the roentgenogram is acknowledged to be very inconclusive as a sole diagnostic index. The human element in roentgenography is all important and probably can never be standardized. The penetrability of the rays is inconstant; variables in development are uncontrollable, and no two pairs of eyes ever see exactly the same things in a film. Little importance can be attached to statements as to what the roentgenogram does or does not show in the borderline cases.

There are those who still cling to the belief that it is possible to extract teeth without contaminating the root surfaces or even the canal contents. Even a microscopic gingival lesion permits ready ingress of bacteria to periodontal lymphatics, far beyond the reach of germicides.

In the papers that I have read which deal with the necessity of extracting any and every tooth against which anyone may, for reason or otherwise, harbor a suspicion, there appears little if any expression of regret at thus being compelled to mutilate the patient. Some of these writers, to the contrary, express the enthusiasm of accomplishment in that they have so easily and quickly relieved the patient of all possibility of disease. They do not often give any considerable number of case histories dealing with the months or years immediately following this radical treatment.

As some of our medical confrères are beginning to call our attention to this mutilation, we may begin to take cognizance of it.

Elliott[13] expresses the situation very nicely by stating that "the dependence of the nutritional state of the body on the teeth as a masticating mechanism is obvious and requires no discussion other than the statement that general practitioners of medicine are apt to under-estimate the importance of an adequate masticating surface as a prerequisite of good health."

Miller[16] also sounds the warning that it may be a serious matter to impair the masticating surfaces of undernourished or enfeebled elderly patients by extracting the teeth, even if some of them should show small root abscesses. He further warns that such procedure may destroy the limited reserve of the patient and have disastrous results. Doubtless, many of us have seen just such consequences.

The physical norm is largely a matter of nutrition. Nutrition is dependent on assimilation, assimilation on digestion and digestion on mastication.

Potts[7] says that in the case of a person who is not seriously ill, but is suffering from some condition which bears no pathologic relation to the organism found in these granulomata, and has some useful pulpless teeth which, even though infected, have only a small amount of bony absorption about the apices, he emphatically advises against the removal of the teeth.

Few would be so extreme in conservatism as to say that when a patient is ill as a result of infection by some organism which has been definitely located in infective number and virulence about the apices, these teeth should not be extracted. "Diseases desperate grown, by desperate appliances are relieved, or not at all."

In this apparent effort to sterilize the oral tissues completely, the dentist is setting himself to an impossible undertaking. Many physicians are also causing us to offend in this particular, demanding that we do in the mouth what they do not expect to do elsewhere in the body. The surgeon does not expect to sterilize completely any area in which he operates. He drains the abscess instead of excising it. Nor does he seem fearful of any serious systemic effect on the patient from this undoubted primary focus, or manifest any alarm as to the possible creation of secondary foci. The same surgical principles which apply to all other parts of the body apply equally to the oral cavity. There is no known physiologic reason why a pulpless tooth, even if infected, cannot

be made sterile, and, if sterile, be as safe as any other.

The question now arises as to what should be done with these infected teeth if they are not extracted. How can these most necessary organs be beneficially retained for the patient? That this can be done cannot be denied because it has been done from time immemorial by Nature herself in the closure of the root openings with cementum, and by many careful operators in the successful sterilization and root filling of these teeth.

Jasper[21] tells us that pulp removal and canal filling in non-infected teeth offer a favorable prognosis when done with the same delicate care that other surgical operations demand. That it is a delicate operation and a difficult one few will deny, but these facts are not prohibitory. On the contrary, they are stimulating to those who are interested in this problem. He implies that cases to be so treated should be carefully selected, but gives no criteria in the selection. The same demand is made by numerous other writers, with the same absence of limitations. I place few prohibitions on cases to be treated. For diabetics, nephritics, the tuberculous and syphilitics, I do not attempt to treat pulpless teeth, infected or sterile. Twenty years of this work has, to me, proved them to be inoperable, but as to the size of the infected area in other cases, I have as yet established no limitation. We are not able to predict what Nature can do if we give proper assistance and not too much of it.

I again quote the lucid and logical Hatton[2]:

> Our studies made on pulpless teeth harmonize with those of others, indicating that pulpless teeth are not dead teeth, and that even teeth with infected pulps and apices, under certain conditions may be treated with a high percentage of successful results.

We formerly thought that the dentin of a pulpless tooth was necrotic, or at least deprived of nourishment, but the work of Coolidge and Blayney seems conclusive evidence to the contrary.

Under the conditions of no definition, no limitations, we are justified, in fact obligated, to push our experimentation until we determine just what the limitations are. It is our duty, which cannot be gainsaid by any theory, to preserve the masticating surfaces of our patients' teeth. As Kells[22] expresses it: "We are not justified in extraction until we have made every effort, unsuccessfully, to restore the tooth to a healthy condition."

O'Brien[23] adds his voice very effectively on this subject, with special reference to patients in poor physical condition, when he warns that if a patient is rendered toothless in the presence of even a severe degenerative disease, he may be definitely harmed, and, further, if these patients are rendered even partially edentulous, their nutrition may be so interfered with that the disease is affected unfavorably. Such sequelae have frequently been noted by observing physicians as well as dentists.

Blayney,[24] after many years of observation, and the care of many thousands of cases, states that, as far as he has been able to observe, the fact that a tooth has lost its pulp or even, in some instances, that a degenerative change is in progress around the root end, is not sufficient reason for the extraction of that tooth.

Miller[16] expresses himself as opposed to the extraction of teeth merely because they are pulpless; and he further states that sufferers from chronic arthritis whom he has attended have, as a rule, had many or all of their teeth extracted without effect on their joints. The commonly known tendency of this disease, as of others of supposedly focal origin, to have remissions and exacerbations, periodic or otherwise, accounts for many of the apparent benefits resulting from dental treatment.

Burger[25] expresses similar views in a very conservative manner when he states that, in selected and favorable cases, pulpless teeth, even when diseased, can be

rendered innocuous and may be retained with benefit.

Findley[1] states that the removal of a pulpless tooth as a preventive measure is unwarranted, and Elliott[18] goes somewhat further by emphatically stating that the extraction of a devitalized, but not manifestly infected, tooth is to be condemned.

All of the foregoing take direct issue with Rosenow and his school, whose beliefs appear to be well summed up by William C. Miller[26] who states, somewhat conservatively, for their side: "Summing up then, it would appear that when there is definite systemic disturbances, all pulpless teeth should be regarded with suspicion and removed."

For this group, mere suspicion would wreck many mouths regardless of other physical burdens and hazards.

The word "conservation" has been disregarded and apparently only one thought remains: the complete extermination of all teeth except those with a history of maintained pulp normalcy. Any history or suspicion of pathosis brings immediate sentence of extraction.

For their spectacular results, this group depends on the indefinite and undependable evidence of animal experimentation. The realist knows that clinical evidence is the only scientific evidence. Laboratory or animal experimentation, while interesting and in many ways informative, has little if any demonstrable connection with the patient. This is excellently stated by Joseph L. Miller[27] as follows:

> As for animal experimental work going to prove that root abscesses are the cause of chronic arthritis, only a little thought is required to show that such evidence is of little value. The patient with a chronic root abscess has probably developed a degree of immunity to the micro-organism, which has also lost some of its virulence. To inject a massive bouillon culture from such a tooth into the vein of a non-immune rabbit and to have an acute polyarthritis develop is not evidence that this micro-organism is responsible for the patient's chronic arthritis. However, this is the proof we are asked to accept.

Not only have we been asked many times to accept such proof, but also, in our thoughtlessness and desire to be "scientific," many of us have accepted it. Findley[1] has some illuminating observations to make to the effect that animal experimentation has led to erroneous conclusions. He says that it is one thing to inject a culture from a pulpless tooth into a rabbit, but quite another thing to contemplate the effect of a slow absorption from a pulpless tooth by the human body. He points out that 5 cc. of a bouillon culture injected into a rabbit would be the equivalent of nearly a half-pint of the culture for a man weighing 160 pounds. Also, this culture is suddenly introduced into the vein without giving time for any local or general immunity to develop. He correctly states that when this is done, something is as sure to happen to the rabbit from the 5 cc. as to the man from the half-pint injection.

Scientists do and say many unscientific things, but I think this experiment ranks with the most unscientific of all. To make any claim or pretense that such an injection would be in any way comparable with the excretion of minutely small quantity of toxins by the few hundred or thousand bacteria in a chronic apical lesion is the ultimate in absurdity. In the acute stage of the abscess, absorption of toxin may be rapid, but in the chronic stage, local resistance and immunity has been built up to the point where there is a practical balance between immunity and infection, with an incalculably small quantity of toxins or small number of bacteria invading the circulation of the host.

Joseph L. Miller[27] further claims that it has not been proved that root abscesses are responsible for systemic disease and that such proof must be obtained from the clinician and not from animal experimentation. In a recent paper, Finkle[28] takes issue very strongly with Rosenow, and states that, though this teaching has been prevalent for many years, gradually the idea is becoming accepted that the

theory of selective affinity of Rosenow is not an established fact. He says that many attempts have been made by capable investigators to duplicate Rosenow's experiments, but that they have failed. He also quotes Zinsser as saying: "Other observers have not been able to confirm this (Rosenow's) claim, and indeed it is very unlikely that such a thing occurs."

He also believes that this theory has influenced clinical thinking to an extent not warranted by experimental fact, and that, in the elective localization of organisms in the tissue, it seems much more likely that tissue factors are paramount, such as hypersusceptibility or local reduction of resistance. These are all logical, well-stated points, to which the scientific or even unbiased mind must give ample consideration.

Much of the argument of the radical school has been based on the coincidence of arthritis and oral foci. The types of arthritis in question are known as osteo-arthritis, hypertrophic arthritis, arthritis deformans, etc. These are the types so frequently found in patients in their forties or older. Many authorities of note are denying the existence of a relationship between these two conditions. In the paper previously referred to, Finkle[28] emphatically denies it, asserting that arthritis is distinctly a manifestation of a general disease and that of all the theories that have been advanced to explain the nature of rheumatoid arthritis, not one of these alone offers a satisfactory explanation of the various manifestations of the disease, and that, after tonsillectomy, sinus operation and removal of all of the teeth, the problem is to find some other tissue or organ that could be removed in the hope of finally finding the so-called focus of infection. O'Brien[23] states that arthritis is a chronic generalized disease, in which, however, the most obvious symptoms and signs are in the joints. He further states that focal infection in osteo-arthritis plays a minor, if indeed any direct, rôle, and that clinically there does not appear to be any close relationship between focal infection and osteo-arthritis.

Joseph L. Miller[29] rather startles us with the following statement: "Acute arthritis is generally considered as originating in the throat, especially in the tonsils." He says that many of the sufferers from chronic arthritis whom he has seen have long had many, or all, of their teeth extracted, and that a common remark is: "I had all my teeth extracted, but I am no better." He says that this condition, as well as many other chronic conditions formerly thought to be due to focal infection, are just as much a problem today as they were before the pronouncement of this theory. He asserts that he has reached this conclusion after a rather extensive experience, and adds that perhaps our attention has been centered too closely on circumscribed foci, overlooking the nasopharynx with its islands of lymph tissue and structures of the posterior nares, where it has been shown that bacteria readily invade the tissue and thus gain access to the circulation.

The proponents of the theory in question have not mentioned such points as these, even to deny them, but assuredly they could not have overlooked them. Science weighs all theories as well as facts and coldly eliminates or accepts, as the case may be. It never disregards.

O'Brien[23] states that, in regard to rheumatoid arthritis, the majority of workers in this field either doubt or flatly deny that focal infection is a causative factor. He himself, however, does not seem to be among that number, for he states that focal infection is of great importance in rheumatoid arthritis and is of minor importance in osteo-arthritis.

Rudolph[30] states that etiologically arthritis may be considered as syphilitic, gonorrheal, tuberculous or metabolic, and that the metabolic or toxic type is the most prevalent, including about 90 per cent of all cases; yet, he says, it is precisely this metabolic type that usually

receives the least attention, adding that the vogue of eliminating foci of infection, real or imaginary, has unfortunately largely overshadowed all other methods of treatment. The average dentist knows full well the truth of this statement, for we have seen even extreme and virulent cases of infection of other tissues completely overshadowed, and often neglected, on discovery of a small chronic radiolucent area about the apex of a tooth. Indeed, these conditions are often laid entirely to the dense circumscribed granuloma, which may be entirely sterile or, at worst, may contain only a few thousand organisms of low virulence.

The question then presented is: If we are not to extract these pulpless teeth, infected or otherwise, what shall we do with them? The answer is not new or unfamiliar to this audience. From the beginning of time, Nature, unassisted, has been sterilizing these infected apical areas, and, from the beginning of modern dentistry, many operators of note have been greatly assisting Nature in taking care of an ever-increasing percentage of such cases.

The success of the operation of pulp-canal filling has long since been established, and this notwithstanding the fact that only a minority of the profession practices it at this time. Our efforts to eliminate periapical infection by electrochemic means are far more successful than in any other infected field. The work of such men as Walker, Blayney, Cooleidge, Hospers, Jasper, Hall and Rhein is well known and is generally admitted by authorities to be successful.

The proofs of the germicidal effect of electrosterilization seem beyond contradiction. Appleton,[31] one of our conservative and scientific men, states his belief that a pulpless tooth may be retained if its periapical tissue can be rendered sterile and if this tissue can be restored to, and maintained in, a state in which its resistance to infection is normal. He further makes the definite statement that the bacteriologic effect obtained by electrosterilization is bactericidal. Blayney[24] reported careful recordings of a thousand cases, and states that both laboratory and clinical evidence is at hand to demand the placing of root-canal therapy on a basis that is not antagonistic to body reactions. On the same point, Grossman[5] says that although one doubts that root-canal therapy will ever be perfected in the true sense, it is nevertheless possible to practice root canal therapy as successfully as other branches of the healing art. In these statements, recognized authorities take direct issue with the "100 per centers," and they prove their case by both clinical and laboratory evidence.

The laboratory experiments on electrosterilization by Grossman and Appleton were handled in an entirely scientific manner, apparently with every possible check and safeguard, and their findings carefully recorded and tabulated. I myself have duplicated their Petri dish experiments though in a less scientific manner and, in every series, I found their claims substantially correct. After their experiments, Grossman[5] makes the conservative statement that electrosterilization, when intelligently applied, is probably the best method we have for the conservative treatment of pulpless teeth.

There is no known reason that infection should not be as easily conquered in this area as in any other part of the body; for it is true here as elsewhere that "the tendency of all disease is to recover." In this field, as in others, some assistance is required, and we need only to learn just what the local and systemic requirements are in order to permit of perfect healing and sterilization of the lesion.

Hatton[32] concisely states just what takes place after successful treatment and filling of a pulp canal when he explains that the process is similar to the healing of a broken bone. First, there is a period in which the necrotic and damaged tissues are removed or resorbed. Secondly,

there occurs a regeneration in which new tissues are formed in the apical region and about the filling material. The dentin and cementum of the apex, both inside and outside the canal, are covered by new layers of osteoid cementum. Occasionally, this layer even covers over the end of the root-canal filling. Nature uses the same means and methods here as elsewhere in the body. In the infected case, if by electrosterilization we destroy the nidus of infection and hermetically seal the canal, in the great majority of cases prompt healing and filling in of the area by normal sterile tissue will follow. In non-infected cases, as in pulpectomy, if the case is handled with care as to sterility, all organic tissue removed from the canals and the canal hermetically sealed, the incidence of complete recovery and the permanent retention of that tooth is as high as for any other tooth in the mouth.

I have been using electrosterilization for twenty years and find its results highly satisfactory. Case records will show a minimum of 80 per cent of the infected cases entirely without discoverable pathologic symptoms for whatever period of time the patient will return for checking.

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Discussion

U. Garfield Rickert, Ann Arbor, Mich: This is a most appropriate time for such a discussion, especially coming from one so well qualified by practical experience. Some time ago, the author of a certain textbook requested me to write a chapter on the subject of focal infection. I finally undertook the writing of it, but found it to be a most difficult task. The recorded literature of textbooks of necessity must be conservative and unprejudiced. No dental subject has ever met with so many heated and opinionated discussions as this one. The recording of the prejudiced, personal views has no place in the literature, certainly not in a textbook, unless it is frankly presented as theory and a basis for further study. For instance, Dr. Johnston has inferred, and rightly so, that the phenomenon of elective localization is still an unproved theory, a statement appropriate in this discussion. I should go a step farther and frankly admit that the focal infection concept has, as yet, not been removed from the realm of theory, an inappropriate statement for a textbook. While there is much convincing clinical and experimental evidence in its support, every effort at its entire proof has found at least one missing link in the chain of evidence.

In my personal investigation of the theory, in at least one instance using myself as the guinea-pig, I believe that I have come as close to proving the conception as any one has, but the true scientist may rightly question even this case, for there is some evidence missing which limits absolute proof. However, with all the inconclusive proof, it must be said that down through the ages, nearly every century produced some clinicians who observed and recorded a relation between diseased teeth and certain systemic diseases. While it is possible, it is not highly probable that all these clinicians were in error. So the theory has reached a status where it must be considered in the diagnosis and treatment of a number of systemic diseases.

During more recent times when the subject was being investigated, the evidence given in either support or repudiation of the focal infection theory was based largely on both clinical evidence and laboratory experimentation. Dr. Johnston, if I understand him correctly, somewhat underestimates the value of laboratory experimentation. The most convincing evidence that we have in support of his view of root surgery is, I believe, the confirmation of clinical experience by laboratory experimentation. It is just as easy to draw erroneous conclusions from clinical observations as from experimental results. I am just as ardent an advocate of skilful root surgery as Dr. Johnston, but if I had been compelled to arrive at these conclusions from clinical observations alone, my respect for the practice would be less enthusiastic. Should any one be interested, he will find here in the exhibits, for example, our bacteriologic studies and histopathologic sections that are not guesswork, but really prove periapical regeneration following adequate root surgical treatment.

Twenty or more years ago when this subject was presented to me for study by the University, I assumed it with fear and consequent caution. In a state university such as ours, members of both the medical and the dental profession referred hundreds of patients to us for help in the diagnosis of diseases suspected of being focal in origin. It took us two years to perfect a technic which was fairly reliable in the culturing of teeth. Much of the confusion that has arisen is due to reports from cultured material, too frequently nothing less than contamination from the oral flora. Then, too, in the so-called granuloma, we may have the

presence of organisms isolated much as the millions of organisms in the mouth are isolated by distinct barriers to the deeper structures. Briefly stated, unless the presence of organisms produces inflammation, their presence cannot be accepted as an infection.

After examining many hundreds of these referred patients, it was found that there were at least two different types of rheumatic diseases with which the dentist is continually confronted when he is called in counsel with physicians, and by rheumatic disease I mean that group of diseases of somewhat identical, etiologic background which includes myositis, neuritis, arthritis and iritis. We shall rule out at once those cases that are associated with venereal disease, tuberculosis, typhoid, etc., since they are seldom referred to us, for the physician understands the probable etiologic background.

It was early observed that these patients fell into two rather distinct groups. It was noted that in one group, wherein dental infections were proved by culturing methods, a considerable percentage of cases were followed by notable and permanent recovery on treatment or elimination of the infections. We observed in the second type, however, that permanent relief from such treatment was seldom, if ever, attained. Since there was no authoritative classification at the time for these two types, we spoke of them as the hyperstreptococcic and hypostreptococcic-susceptibility types. It was noted that in the hypersusceptibility types, the patients were usually found in the lower age brackets. Occasionally, these types were found in patients who were more than forty years of age. It was also observed that the hypersusceptible type usually had a slightly lowered erythrocyte count and a slightly higher leukocyte count; while in the opposite form (the hyposusceptible type), the blood picture was usually normal. The susceptible types were usually, slender, somewhat undernourished persons; whereas the opposite were usually well-nourished and frequently somewhat overweight. Agglutination tests were usually positive in the susceptible types and negative in the nonsusceptible. Bone changes in the two types were also different. There were many other differences, but this will give you an idea of the two distinctive forms with which the dentist should be familiar. I repeat that, in the former type, a considerable number received permanent relief from secondary effects by the elimination of all foci of infection; whereas the second type received little or no benefit following the elimination of such foci. It is important that in our diagnosis and prognosis, we know that 75 or 80 per cent of arthritic cases belong to the second type and now are believed to be initiated by some other condition than infection.

More recently, both in Europe and America, committees have been appointed to make a thorough study for the control and relief of rheumatic diseases. The most valuable part of their contribution so far is that they have given a pathologic classification to these diseases clinically identical to our observations noted above. With a knowledge of the essential differences of the two major types, one may now with a reasonable degree of accuracy make an intelligent diagnosis and prognosis as to the outcome that a patient may anticipate by the elimination of dental and other foci of infection. This will also explain why the promiscuous extraction of teeth has proved so disappointing, as was brought out by Dr. Johnston, since the hyposusceptible types have comprised from 75 to 80 per cent of these cases and do not appear to be etiologically related to infection. Since relief is more common in the hypersusceptible type, it is easy to understand the confusion regarding the subject and the disappointments following promiscuous extraction, with no knowledge of difference of types.

There is no longer any excuse for promiscuous extraction. The operator should familiarize himself with these two

types. His diagnosis and prognosis may now at least be intelligent. The dentist will save himself much embarrassment and increase the confidence of the patient in his judgment if he avails himself of this information.

If I were to criticize this report of Dr. Johnston's in any way, I would say that he took the enthusiast's way in that he devoted more time than necessary in the presentation of opinions and conclusions of the many investigators obviously on our side of the question. It is only fair that the opposite findings with attendant opinions be presented more fully, with a possible explanation of the investigator's error in the evaluation of results. To illustrate: It is true that the elective localization or tissue virulence phenomenon has been difficult to study and duplicate because of the many precautions that the observer had to take into consideration in the selection of his cases and the experimental technic. I too came near being misled here; in fact, it was only by accident that I discovered the reasons for my previous failures. We must take into consideration that Dr. Rosenow is dealing with quite a different type of patient from the type we meet in daily clinical experience. I seldom, if ever, was able to demonstrate this phenomenon on the regular dental clinic patients. It was only when I carried this experimental work to certain hospitalized and well-advanced cases that I was impressed with the observations. Elective localization is a reality and not a myth, but we are quite certain that many of these specific organisms that we isolated from teeth were secondary invaders from the primary focus and were not the initiating factor in the systemic disease. We are quite certain now that many of the organisms isolated from teeth were secondary invaders. This explains why, in the most spectacular instances of selectivity, removal of the teeth did not materially affect the primary focus.

We, like Dr. Johnston, are less disturbed about dental infections and their sequelae than we were in the earlier days. We believe that such infection should be removed whenever possible but that the operator should not be overzealous and, in his attempt to eliminate infection, introduce additional, destructive processes having a greater influence on the patient's health than the presence of some of the rather well-fortified, affected teeth. The latter condition should occasionally be considered.

We also agree that adequate root surgery gives our patients a service frequently unequaled by any other measure available to the dentist, and that we now have at least three types of treatment that are effective in the management of periapical infections: (1) plain drug treatment, (2) electrosterilization and (3) root section. In our large teaching clinic, the last has been carried on for about twenty-one years and nothing else that we do provides a longer health service and greater satisfaction to the patient than root surgery if the operation is properly managed.

I agree with Dr. Johnston that operative practices have been carried to a point of effectiveness where it is seldom necessary to extract any tooth of strategic importance, and certainly seldom necessary to extract single-rooted teeth of such importance.

IMPORTANCE OF EARLY RECOGNITION AND TREATMENT OF PERIODONTOCLASIA

By J. Clarence Salvas, D.D.S., Philadelphia, Pa.

PYORRHEA, or periodontoclasia, has become of increasing public interest owing to the influence of the public press, to the numerous articles on health they have published, together with the activities of our research workers in their endeavor to further understand the etiologic factors in disease of the periodontal tissues, on which volumes of conflicting opinions have been written. The reaction of the dental profession to this remarkable propaganda regarding the importance of mouth health has been to further our studies in diet, metabolism, the endocrins and the vitamins, though their exact rôles in dentistry are somewhat difficult to evaluate. Dental research workers are doing excellent work in interpreting and showing the intimate relation between systemic disease and diseases of the mouth. Pathology, or the study of disease processes, includes histopathology, clinical bacteriology and clinical pathology. Moreover, it embraces a knowledge of the etiology, growth, microscopic and other changes and behavior of abnormal or diseased tissues.

In comparatively recent years not only have tremendous strides in dental pathology been made in this country, but especially meritorious studies have been presented from Germany, on the teeth and their supporting structures. Therefore, we have a clear understanding of the character, structure and function of the tissues of the periodontium, together with their relation to each other. These tissues with which we are especially concerned are the gingivae, the pericementum and the alveolar process. Their intimate association results in a vulnerable point which Nature has endeavored to protect by the elongation of the gingivae; but the fact remains that the tissues of the periodontium are more susceptible to disease than any other tissues of the mouth. This is true for the reason that these structures are subjected to great stress, the frequency of disturbance in function is greater than in any other part of the body and they are continually open to bacterial invasion. Then, too, it must be remembered that the periodontal tissues are really end organs, their circulation being of the terminal rather than the anastomotic type.

In their etiology, they are not uniform, nor are they uniform in the course of their pathologic disturbance. There are types of cases in which the predominant factors are systemic, metabolic or dietetic. On the other hand, there are cases in which the local conditions are most prominent. To the trained eye, each may be apparent from the clinical course which it pursues.

The most common of the diseases affecting the periodontium, the ones we meet with in daily practice, are gingival recession, gingivitis, Vincent's infection and periodontoclasia. Each may present a variety of symptoms and they may be so fused with one another as to make diagnosis and treatment very difficult. Then, too, complications arise, such as periodontal abscess, which not infre-

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quently develops in the investing tissues about a tooth with a deep pocket, or a periapical infection or abscess, having similar symptoms but requiring different treatment. It is essential that we be thoroughly familiar with the different types of these diseases and their differential diagnosis that the necessary treatment may be administered before their development reaches a stage where treatment is difficult and cure doubtful.

In the study of these diseases, one is impressed with the fact that although they may differ one from the other, they have one characteristic common to them all: the symptoms first appear in the gingivae and through the gingivae disease enters the periodontal tissues. If this tissue could be maintained in health, it would be possible to prevent the development of most of the diseases which involve the periodontium. Therefore, the importance of keeping the tissues in health cannot be emphasized too strongly. The initial stage of periodontal disease is a mild, inoffensive, but insidious inflammation of the gingivae. It will often pass unnoticed. In fact, it is sometimes difficult to detect; but, in its progress, through continuity, it involves the adjacent tissues, slowly destroying the pericementum and the alveolar process, causing the gums to recede and the teeth to loosen. Conditions are created that are, to a great extent, irreparable, regardless of the treatment. The development and progress of most of these diseases depend on the presence of bacteria. These organisms, except those concerned in Vincent's infection, are not specific. They represent the normal bacterial flora of the mouth, the principal offenders being the staphylococcus and the streptococcus. These organisms invade and break down the tissues of the periodontium under conditions of lowered resistance. Of the various types of these diseases, periodontoclasia, known by the familiar name of pyorrhea alveolaris, has been the *bête noire* of dentistry from its very beginning. This is because of its complex etiology, its many pathologic symptoms and the exacting character of its treatment, all of which have conspired to make of it a disease of mystery. It has been defined by Simonton as a condition characterized by a retrograde metamorphosis of the periodontium, including degenerative changes of the investing tissues having a number of diverse causes. The clinical symptoms of the disease are inflammation of the gingivae and the pericementum, resorption of the alveolar process, pocket formation, gingival recession, suppuration and tooth mobility.

In the preliminary stages, some of these symptoms may be absent, but no case can be diagnosed as periodontoclasia without the systemic factor of low tissue tolerance in which impaired circulation, infection, alveolar resorption and pocket formation are not, at least to some extent, present. It must be remembered, however, in making a differential diagnosis that the pocket is always present in periodontoclasia.

Alveolar resorption and infection may be present in the absence of the disease. A pocket consists of two walls, the gingivae and the surface of the root. Its formation is a progressive phenomenon. Starting as an inconspicuous lesion in the gingival crevice, it advances toward the apex, slowly destroying the pericementum and the alveolar process in its progress. It is readily detected by slipping a blunt probe beneath the marginal gingivae. Pocket formation and bone resorption generally occur on those surfaces of the tooth root on which there are calculary, bacterial and filth accumulations, rather than on those that are more accessible to the cleansing and stimulating influence of fibrous foods and the toothbrush. Therefore, pocket formation is most frequently found in the proximal spaces and on the lingual surfaces of the teeth, especially the molars and bicuspids. There are exceptions to this rule, but even then some factor such as occlu-

sal stress, lack of functional activity or uncleanliness is present to cause at that point an area of low tissue resistance.

It is not unusual, in mouth hygiene, that certain areas are better cared for than others, with the result that such areas have a higher resistance to periodontal disease than those receiving less attention. It is interesting to note that this disease process often involves but one or two teeth and that alveolar resorption and pocket formation will reach an advanced stage while the other teeth in the same mouth remain unaffected. It seems in these cases that systemic conditions are not the controlling factors. Extract these teeth and there follows complete healing of the tissues of the periodontium. Inflammation and suppuration are checked at once. What actually happened on the removal of these pyorrheic teeth was the elimination from the periodontium of the condition favoring bacterial activity; that is, the pocket and dento-alveolar junction. Pocket formation is the distinguishing characteristic of pyorrhea. This is fundamental. Bacteria are responsible for the formation of pus, but it is not so definitely diagnostic of pyorrhea as the pocket is, since we may have bacterial activity in other periodontal diseases. In no department of dentistry is diagnosis of more importance than in periodontia, which has to do with that which is fundamental in dentistry: the health and well-being of the supporting tissues of the teeth.

The etiology of periodontoclasia is undoubtedly complex, having different aspects in different persons. Treatment and prevention depend on the isolation of all factors in each case and their proper disposal. The two fundamental factors concerned in the disease are low resistance and bacterial invasion. All other causative agents, such as excessive occlusal stress; food impaction; the presence of serumal calculus and defective crowns; poor contact relations; functional inactivity; oral sepsis, and faulty diet are important etiologic factors, principally as they contribute to lowering resistance or increasing the bacterial flora. In addition to the foregoing, an etiologic factor frequently met with is faulty structural development of the tissues, as in a faulty cemento-enamel junction and poorly calcified bony tissue. Frail osseous support has much to do with the progress of the disease; also histologic faults in the crevicular epithelium of the marginal gingivae. The importance of food impaction as a causative factor cannot be overemphasized. There are few cases in which it is not met with to a greater or less extent. The packing or jamming of food into the interdental space injures the septal gingivae and destroys their protective function. Nature has made a nice provision to prevent this by the interlacing of tooth with transseptal fibers of the pericementum, which functioned satisfactorily with primitive man, but fails to meet the needs of our present civilization.

Much research work is being done along the lines of vitamin deficiency and its relation to the peridental tissues. So long as no definite etiologic bases have been found for these diseases, attention must be given not only to symptoms in the mouth but also to the general health of the patient. Noss, in the 1936 Year Book of Dentistry, states that paradentosis is not local, but usually the expression of an underlying systemic disease.

PREVENTION

However skilful the treatment may be for diseases which break down and destroy the periodontal tissues, it can never be wholly satisfactory, since diseases in these tissues create a condition that, to a great extent, is irreparable. Therefore, the value of prevention and early treatment cannot be overestimated. Complete success in the field of prevention is not always possible. As previously stated, there are etiologic factors in certain periodontal diseases such as periodontoclasia that are not wholly understood and can-

not be brought under complete control. This is especially true in that type of pyorrhea in which the etiologic factors are associated with abnormalities in diet and nutrition. We do not meet with these cases frequently; but when we do, local preventive measures are always most helpful, if not actually successful, and this is accomplished by improving tissue tone and increasing cell resistance.

Preventive measures meet with the greatest success in local conditions in which the factors include oral sepsis, dysfunction, low resistance and the presence of bacteria. These conditions can be brought under control and a large percentage of periodontal diseases can be checked in their incipiency.

In the work of prevention, we endeavor to accomplish two things: promote the circulation in the periodontal tissues, thereby increasing their resistance to disease, and reduce to a minimum, through prophylactic treatment, the bacterial flora of the mouth. If the teeth could be given the stimulation of vigorous exercise in the function of mastication, many diseases that they are now afflicted with would cease to exist. Irregularities of the jaws and of the teeth and impaction and absence of teeth can be directly traced to the degenerative influence of relative disuse. It is of great importance, therefore, in the prevention of periodontal diseases, that tissues be well nourished. The natural way to accomplish this is through function. Patients should be encouraged to use the teeth and jaws vigorously. Food should be of a character to require vigorous chewing and it should be masticated far more thoroughly than is done by most people. Thus, we would improve not only the teeth and jaws, but the general health as well.

In the field of prevention, not only of periodontal disease but of all dental diseases, there is nothing more important than a thorough and comprehensive examination. It is unfortunately true that, in the rank and file of the profession, many examinations of the mouth and teeth are inadequate. Too frequently, it is but a perfunctory search for caries or to determine the need of a prosthetic restoration or the presence of salivary tartar, but with no thought for the condition of the supporting tissues and no attention to diet or conditions of general health which are important factors in the local situation. The matter of focal infections arising from a diseased periodontium and putrescent nerve canals is often neglected in the examination, and periodontoclasia is frequently far advanced before it is discovered.

A thorough examination of the mouth must include a full roentgenographic survey and each tooth should be tested for vitality. Its purpose is the prevention and treatment of dental disease, and it comprises a search for caries, faulty contact points, oral sepsis, pulpless teeth and malocclusion, and determination of the condition of the investing tissues. It not infrequently happens in examination of the mouth that health conditions outside the field of the dentist, but which may unfavorably affect the treatment of dental diseases, are uncovered. The patient should then be referred to the physician, the dentist thus rendering a more valuable service to the patient than were he to confine himself to dental considerations.

Normal healthy gingivae are elevated above the alveolar crest to the extent of 1 mm. or more. This relation is constantly changing and varies with the individual. Between the gingivae and the cervical enamel is the gingival crevice, sometimes called the gingival sulcus, gingival space or gingival pocket. It is bounded at the cemento-enamel junction by the attachment of the pericemental fibers. Healthy gingivae terminate in a knife-like edge which hugs the enamel so as to protect the pericemental attachment against injury. It is through this tissue that disease enters the periodontium. The first clinical symptoms appear in the gin-

givae. Could they be kept in health, it would be possible to prevent the development of most of the diseases with which we are concerned.

We must not lose sight of the fact, however, that it is not what is on the tooth that is the source of periodontal disease, but what is under the marginal gingivae. The surfaces of the tooth may be perfectly clean and polished while the gingival crevice is filled with a mass of decaying food débris, calculus, bacteria, etc. This condition can exist with little or no clinical evidence, which is indeed surprising when we note the amount of material that can be jammed into a single gingival crevice. The entire crevice of each tooth must be explored and the contents removed, with planes and curets especially designed for that purpose. No prophylactic treatment or examination is complete that does not explore the gingival crevice. Moreover, the floor of the crevice must be carefully examined for incipient pocket formation, which is often found in the most unexpected places, there being no symptom of a break in the tissues in the floor of the crevice.

DIET IN PREVENTION

The teeth and their supporting structures are living tissues and are influenced by the same factors of nutrition as any other tissues in the body. Diffuse atrophy, so frequently met with in certain types of periodontoclasia, is associated with calcium deficiency or a disturbance in the acid-base balance. It is, therefore, important in the prevention and treatment of these cases that attention be given to diet, in the endeavor to eliminate the disturbing factors. The necessary calcium and phosphorous elements are found in dairy products (milk, cheese) and leafy vegetables. The administration of vitamins A and D as a prophylactic measure is advisable for all dental patients. It is best prescribed in 3 minim capsules or 10 drops a day of plain halibut liver oil with or without viosterol. Vitamin C is also most important and is best obtained in orange juice. One-half pint of tomato juice should be taken each day. The juices of vegetables are invaluable. Sweet carbohydrate foods should be avoided. They satisfy the appetite without meeting the nutritional requirements. Then, too, they leave residual deposits which offer ideal locations for bacterial growth.

To treat periodontoclasia, one must consider its biologic and pathologic aspects. The treatment of disease, Stillman says, consists of measures designed to restore the organism or any of its parts to health. Treatment aims to eliminate those factors which are responsible for the occurrence of disease conditions.

Prophylactic treatment should precede operative treatment. Very often, the former is necessary before the examination. Merritt tells us that treatment has two objectives: (1) the treatment by operative procedure of the pathologic conditions existing in the periodontium and (2) the elimination through operative and postoperative care of the underlying factors of disease in the endeavor to reestablish and maintain the health of the periodontal tissues.

The aim is to establish a high standard of mouth hygiene by which the bacteria, important etiologic factors in the disease, are reduced to a minimum, and regularly and persistently to stimulate the periodontal tissues in an endeavor to raise their resistance to bacterial infection. The importance of this cannot be overemphasized as it is by this means that a cured case is kept in health. If the mouth is allowed to become unhygienic and the periodontal tissues are without the stimulation essential to their health, reinfection is sure to follow whatever else may be done. In this, we are dependent on the intelligent and persevering cooperation of the patients. We must demonstrate to them in their own mouths that the pressure with the brush at the gingival borders forces the blood out of the

venules into the veins and the filling of the venules with a fresh supply of blood from the arteries is a cleansing and stimulating process. Patients will appreciate, indeed feel complimented, if you explain to them the biologic principle involved in reducing congestion in the arteries and venules. Tell them the value of mouthwashes, either a physiologic sodium chloride solution or any other antiseptic wash, when swished about from the cavity of the cheek through the interdental spaces into the cavity of the mouth. The mechanical effort of swishing back and forth between the teeth is stimulating and removes irritating matter that finds lodgment in these spaces.

After the conditions responsible for the development of the disease have been determined, treatment must be instituted along those lines. I repeat: The first step as a preliminary to treatment should, in all cases, be a complete roentgenographic examination, as this is the only way that a working knowledge of the bone loss and the extent of pocket formation about the involved teeth can be obtained. Of course, an examination of this character will not tell the whole story, as bone loss limited to the lingual surface of a root may not be represented in the roentgenogram. Nevertheless, it is of invaluable assistance and should always be a part of every examination. It makes it possible for one to determine the extent of the alveolar atrophy as it involves the buccolabial surfaces and interproximal spaces. Moreover, it pictures the condition of the periapical tissues, pulpless teeth and unerupted teeth. Also, in types of periodontoclasia in which there are absolutely no clinical symptoms of disease, roentgenographic examination is of inestimable value as it will reveal more of interest to the diagnostician than any oral examination. It is obvious, I am sure, that no dentist can practice preventive dentistry and confine his investigation to an oral examination without a complete roentgenographic survey of all the teeth. Eyes, fingers and experience have their limitations.

Dr. Merritt tells us that the operative treatment consists in the subgingival curettage of the involved root surfaces to the depth of each pocket and removal of all calculary deposits and the septic matter that is invariably present on the surface of the root. This requires an exacting and skilful technic and the use of instruments especially designed for that purpose. It is a serious mistake to hold that the sole object in this operation is the removal of subgingival tartar and that this can be done with any set of scalers. The root surface to the depth of each pocket must be gone over with instruments designed for that purpose.

It is not a scaling operation, but a very delicate planing of the root surface to remove its more or less septic and roughened surface. Great care must be exercised not to cut so deeply as to go through the cementum, exposing the dentin.

Drugs, although of little or no value in this treatment, have always been so large a factor in the treatment of disease that the rank and file, especially those who have not made a study of its etiology and pathology, will naturally think in these terms regarding the treatment of periodontoclasia. In certain instances, drugs may be of some supplementary value, but in no case are they ever more than this. Instrumentation is the important step in the treatment of periodontoclasia. It is the only treatment and therefore should be learned by every practicing dentist. Digital dexterity and deftness of touch can be easily acquired. Skilfully handled, there are few cases that require further treatment, with the exception of those in which there are one or more loose teeth that, having lost the alveolar support, are being traumatized by the opposing teeth. These teeth should be ground to relieve the excessive pressure. They can be held firmly in place by ligature. Thorough and painstaking prophylactic

treatment should precede instrumentation.

We learn from the pathology of the disease that its characteristic feature is the breaking down or destruction of the osseous support of the teeth by the resorption of the alveolar process, creating pockets the depth of which depends on the extent of bone resorption. The recession of the gingivae is very slight as compared with the loss of bone. The more advanced the bone resorption is, the deeper the pocket will be, and it is therefore difficult, sometimes impossible, to pass an instrument into the gingival orifice of the pocket that will reach its boundaries. This is notably true of those cases in which the gum tissues are firm, the color is normal, there is no discharge and the gingival entrance to the pocket is constricted. Subgingival curettement is not entirely successful in these advanced cases.

Surgical treatment is the only effective remedy; i.e., resection of the gum, or gingivectomy, by which the gum forming the pocket is excised to or below the involved alveolar process and the root exposed. The treatment is the same as in subgingival curettage, thorough apoxesis, which is more easily accomplished because of its accessibility. This operation should be confined to the posterior part of the mouth or the lingual surfaces of the teeth. It is especially applicable about those teeth in which the pocket and bone loss involve the bifurcation of the molars and where it is difficult to control reinfection. It is also valuable in those cases wherein there is extensive loss of bone, limited more or less to the interproximal spaces, causing a deep pocket owing to the presence of loose and impoverished septal gingivae. Another condition frequently met with follows the extraction of the third molar and the absorption of the alveolar process of the second molar distally. A narrow pocket is formed that is otherwise difficult to manage. We must bear in mind, however, that the one disadvantage is the disfiguring effect due to the loss of gum tissue.

The "flap operation" is limited to the buccolabial surfaces of the gums and is less disfiguring than resection. It is especially valuable in the incisor region where there are several deep narrow pockets. Two incisions are made, extending from the depth of the pocket to the gingival border. Septal gingivae are divided and the labial flap is laid back. Thus, the anterior surface of the several teeth to be operated on is exposed and the lingual surfaces can be reached without a vertical incision. The root surfaces are curetted, all necrotic tissues being removed, and the parts thoroughly cleansed, and the flap is brought back into place and sutured. The sutures should be allowed to remain until union has taken place, which may be in four or five days. This operation is also valuable in cases involving the bicuspid and molar regions, especially of the upper jaw, and those in which there is a deep pocket about a single tooth. An incision parallel with the root can be made from the border of the alveolar process to the orifice dividing the pocket between the anteroposterior boundaries. This will give direct access to the pocket. After the root has been treated, the incised tissues are brought into apposition, where they will usually reunite without suturing. It is well not to lose sight of the fact that the postoperative pain in all surgical cases is much greater than that following subgingival treatment. Local anesthesia must always be used for these operations. If several or more teeth are to be operated on, conductive anesthesia is desirable.

With subgingival curettage, skilfully performed, no anesthetic is needed, as there will be little or no pain. In either method, the object to be obtained is the elimination of infection and obliteration of the pocket. If we make a careful survey of the field of periodontology and a study of the nature of the diseases in-

volving the periodontal tissues, we appreciate the importance and desirability of prevention and early treatment. The destructive action of the diseases of the supporting tissues of the teeth is attended by conditions that are to a great extent irreparable. The receded gingivae, the resorbed alveolar process, the exposed and unsightly root surfaces, the weakened and loosened teeth can never be restored to their original condition. When the disease is far advanced, it may be cured, in the sense of restoring the tissues to health, but that is all. The destroyed tissue cannot be replaced; therefore, the importance of prevention, which can be achieved by simple measures. These consist in establishing functional activity together with artificial stimulation and the continued maintenance of a high standard of mouth hygiene.

Medical Tower.

BIOPSY IN ORAL SURGERY*

By Raymond Gettinger, B.S., M.D., New York City

BIOPSY may be considered a procedure designed to reveal the nature of tissue through direct examination. As such, it is concerned with a wide range of biologic, histologic and pathologic phenomena.

Reaction complexes in the course of morbid processes are naturally of primary interest to the surgeon. Application of their diagnosis to practical ends is his special task. Although this point of view is justifiable and entirely valid, it is somewhat restricted. Questions of histogenesis and pathogenesis are of considerable importance in furthering understanding and thereby increasing the effectiveness of direct action. Biopsy in this respect may supersede immediately practical ends as well as include them.

The clinical diagnosis of lesions of the oral cavity is often uncertain and may even be hazardous. Smears may further confuse the attempt to establish etiologic factors in the case of infectious diseases owing to the fact that secondary contaminants may be misinterpreted. Streptothrix, leptothrix, the endomyces, as well as spirochetes, and the innumerable types of bacteria normally present may appear in such profusion that analysis would be difficult and often impossible. Inflammatory processes of non-specific type are not suitably evaluated in this manner. Serologic aids to diagnosis may be occasionally, but not altogether infallibly, effective. Neoplasms are obviously too complex for casual analysis. The resort to tissue examination under such circumstances is useful in several particulars.

The biopsy should establish whether the lesion is neoplastic, specifically infectious or inflammatory, and may indicate its local or suggest its general nature. This fundamental information would in itself justify the procedure. Further refinements of differentiation extend the value of the examination.

The type of neoplasm, including its histogenesis, grade of differentiation and probable radiosensitivity should be revealed. These data have implications beyond diagnosis, important though this be.

A guide to treatment is offered. The surgeon may plan his approach through

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*From the laboratory of the New York Institute of Clinical Oral Pathology.

operative intervention, radon implantation, the radium plaque, or deep x-ray therapy, depending on his judgment, experience or available facilities.

In addition to this, biopsy may permit an estimate of prognosis. It must be appreciated, however, that the statistical information on the basis of large groups

A B

Fig. 1.—A and B: Metastatic foci of hematogenous tuberculosis involving oral (A) and pharyngeal (B) mucous membranes; healed pulmonary and quiescent spinal lesions.

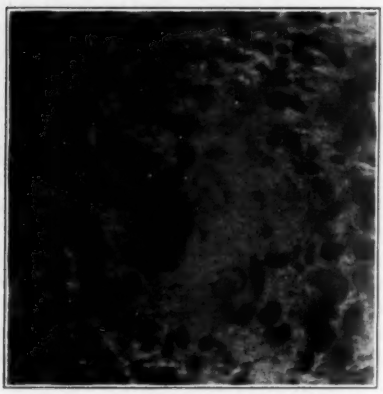


Fig. 1.—C: Tubercle bacilli in giant cell from biopsy specimen from gingival lesion.

cannot be rigidly applied to any individual case.

There are instances in which the further course of the disease may be followed through biopsy control. This may modify both treatment and prognosis.

Biopsy in the specific infectious diseases may present evidence similar in importance to that gained in neoplastic disease. Well-established pathognomonic granulomata form a characteristic group. The presence of the infectious agent and its demonstration in the lesion are unequivocal criteria on which diagnosis rests. Additional problems may be presented and the direction of further investigation be indicated.

The primary or secondary nature of the process may have to be determined in the case of general infections capable of local manifestation. Syphilis and tuberculosis are of preeminent significance in this respect. Their natural history is complex and their course often obscure, and they frequently increase in severity over long periods. The biopsy may be an important, if isolated, factor in the evaluation of the clinical entity.

Treatment based on tissue diagnosis can be instituted along specific lines if these be available for the disease in question. Although such measures may still be relatively limited, at least the fundamental basis for a method of approach is established.

Prognosis, as in the case of neoplasm, is too complex for absolute determination. There may be occasional indications of its probability.

The biopsy may adduce evidence of

positive value in lesions of inflammatory processes of heterogeneous nature by excluding neoplastic or specific infectious diseases which may resemble them clinically. In other instances, more precise information may be revealed, although this fundamental differentiation is a valuable service. The frequent lesions of chronic irritation, trauma and related disturbances so prevalent in the oral cavity often have characteristic, if not specific, manifestations.

The potentiality of the biopsy in this large group is considerable. Oral surgery finds its most useful application under a variety of circumstances in which these common lesions predominate. The reassurance of biopsy must be considered essential, however, if the practice is to be well founded and directed.

Fig. 2.—A: Tuberculoma presenting lesion in case of active ulcerative pulmonary tuberculosis.

It would be advantageous to approach clinical problems through a nosologic plan depending on etiology. Such a method is of particular value to the clinician who would diagnose and treat disease from the most fundamental basis. Although this desideratum is not always capable of fulfilment, it is approximated in numerous instances and under great variety of circumstances.

The Granulomata

Syphilis is not ordinarily considered a disease in which biopsy is a necessary procedure for diagnosis, further observation, prognosis or treatment. Yet the diagnosis of occasional primary lesions of the oral cavity by dark-field examination may be considered as a type of biopsy in the broader sense. This may prove even more useful in the diagnosis of the more common secondary stage involvement of mucous membranes. Although serologic aid has proved to be of inestimable value, occasional confusion of other inflammatory lesions with syphilis may require the further differentiation of biopsy and histologic diagnosis.[69]

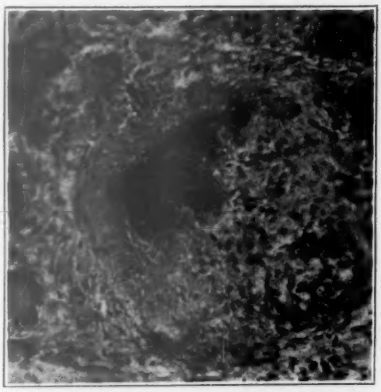


Fig. 2.—B: Biopsy section revealing nature of process and directing attention to unrecognized primary focus.

Late syphilis brings more complex problems, in which biopsy assumes a determinant rôle. This is evident in the lesions affecting the mucous membranes, bones and tongue. (Fig. 7.) The leukoplakia of syphilitic origin shows a peculiar tendency to progress to epidermoid carcinoma.[3, 4, 27] Tissue diagnosis is imperative for lesions that give evidence of such a trend and fail to respond to local or general treatment. Antisyphilitic therapy for infiltrating carcinoma which has been confused by positive serologic

reactions must be regarded as an unfortunate result of incomplete study and ill-directed action that biopsy would have corrected.

Gummatous processes in the tongue, maxilla, palate or mandible may simulate those of other infectious or inflammatory origins to a striking degree. The

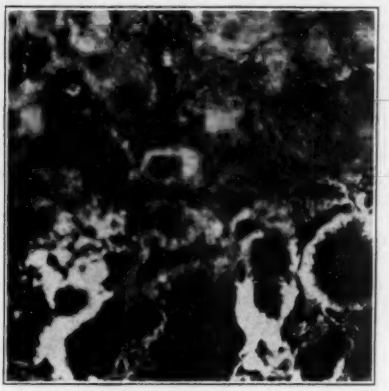


Fig. 3.—Actinomyces (ray fungus) from necrotizing ulcerative stomatitis.

Fig. 4.—A: Chronic granulomatous gingivitis considered tuberculosis or carcinoma clinically.

occasional resemblance to neoplasm may present similar problems. Under such circumstances, serologic evidence may again prove confusing. Tissue examination becomes necessary.[3, 4, 27, 28, 29]

Tuberculosis may present several clinical entities of importance to the oral surgeon. Most frequently, the manifestations of pulmonary disease predominate and the lesions are of obviously secondary nature, although they still require biopsy diagnosis for confirmation. Variations from the usual course may be

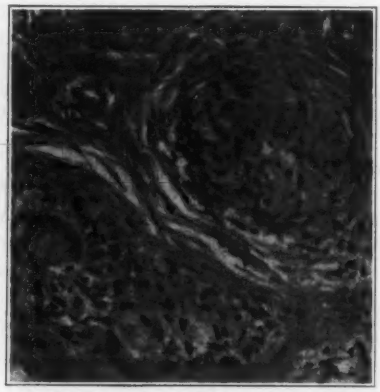


Fig. 4.—B: Foreign body granulomata simulating tuberculosis histologically.

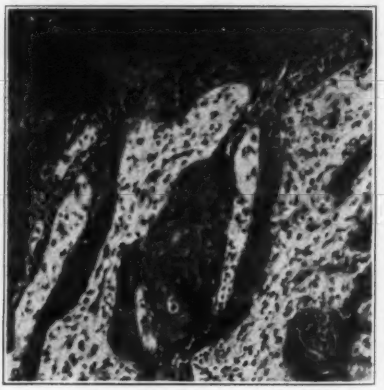


Fig. 5.—Leukoplakia with marked keratinization and atypical acanthosis.

completely misinterpreted without it, however.

Tertiary tuberculosis may produce occasional metastatic foci in the oral cavity. If the locus is in the spinal column and the pulmonary lesion healed or quiescent, it is possible to have a negative sputum

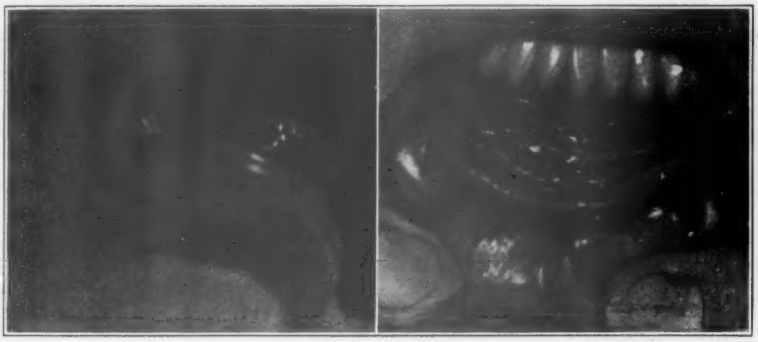
and yet find tuberculomata and ulcerations in the cheeks, sulci, gingivae or alveolar ridges. (Fig. 1.) They might simulate other disease. Their diagnosis by biopsy is essential. Once this situation is evaluated, further investigation for the focus is obligatory.[20]

A more usual possibility occurs under entirely different circumstances, in which active pulmonary disease may escape attention and produce secondary manifestations in the oral cavity. (Fig. 2 B.) Their presentation for diagnosis may be attended with considerable difficulty on a purely clinical basis. The resemblance of ulcerated forms to secondary syphilis may be close. Bulky tuberculoma can suggest neoplasm. (Fig. 2 A.) Here again, biopsy may clarify the clinical setting and direct appropriate study.[59]

Actinomycosis is of less frequent occurrence among the specific granulomata. (Fig. 3.) Smears, crushings and biopsy may be useful in revealing the etiologic factors behind obscure indurations similar to gummata and draining fistulae such as may be noted with apical granulomata or infected cysts.[19, 32, 41, 62]

Other infectious granulomata affecting the structures of the oral cavity, including glanders, leprosy and yaws, have similar implications, although the rarity of the last in temperate climates gives them less prominence.

Granulomata of lipoid histiocytic nature occurring in the course of xanthomatosis of Schüller-Christian's disease may involve the oral cavity and commonly affect the bones of the skull. Gingivitis is frequent. Occasional granulomatous tumefactions may occur in the soft tissues, most frequently following trauma. Their evaluation through biopsy may suggest the constitutional nature of an apparently local lesion.[60]



A B

Fig. 6.—A and B: Hypertrophic cheilitis following prolonged trauma from ill-fitting denture.

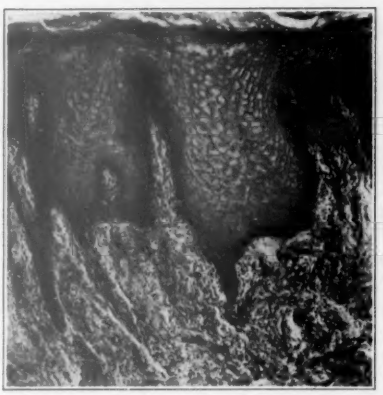
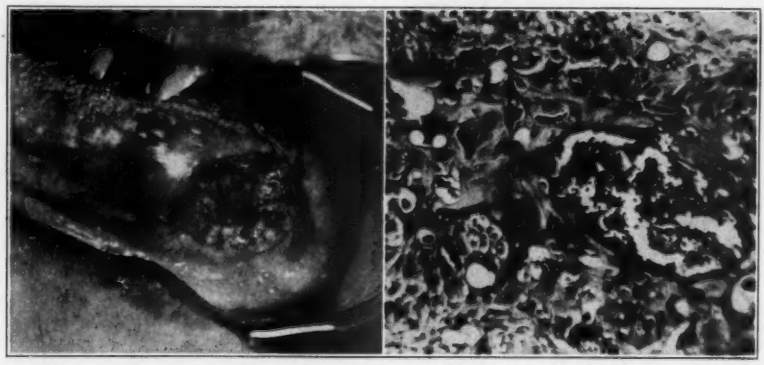


Fig. 6.—C: Marked hyperkeratosis and acanthosis of mucous membrane with low-grade inflammation and fibrosis of corium.

Foreign body and chronic non-specific inflammatory granulomata are not unusual in the mouth and jaws. Filling material escaping into the periodontium is a common etiologic agent. Chronic irritation of other types may be a factor. (Fig. 4 A.) Cases with chronic productive inflammation of the soft tissues with and its removal and examination are not usually considered a biopsy, certain objections may be raised to such a view. The investigation of these lesions for epithelium and an evaluation of its type are of more than academic interest. Cases of small ameloblastomata having the appearance of the ordinary apical



A B

Fig. 7.—Tongue lesion (Wassermann reaction four plus) (A). Biopsy revealed squamous epidermoid carcinoma (B). Cure followed antisyphilitic treatment and radiotherapy locally.

Fig. 8.—A: Lesion on alveolar ridge. The superficial resemblance to tuberculoma (Fig. 2 A) should be noted.

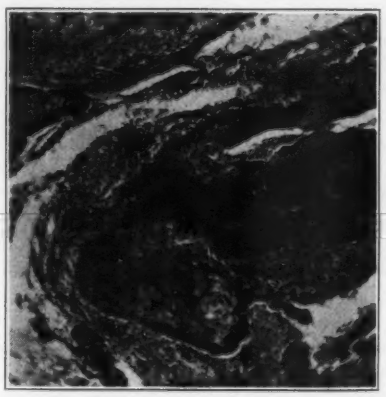


Fig. 8.—B: Biopsy section revealing squamous epidermoid carcinoma.

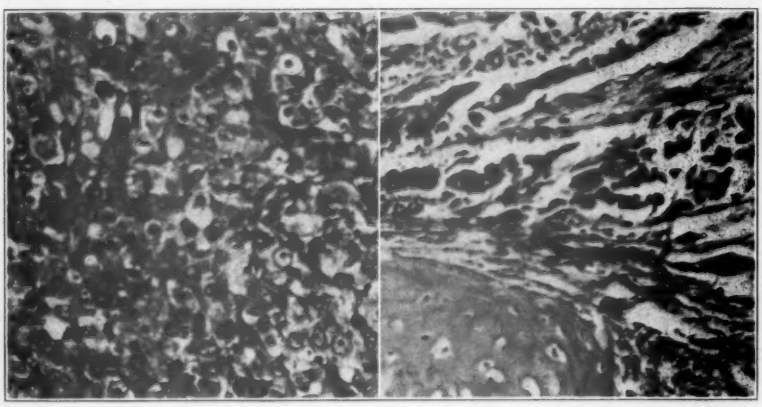
or without osteitis of various types may present problems of differential diagnosis in which biopsy becomes important. (Fig. 4 B.) Tuberculosis or neoplasm may be simulated clinically and roentgenographically.

Although the apical granuloma usually offers no serious difficulty in diagnosis granuloma have been observed.[44] Epidermoid carcinoma has been attributed to epithelium of the type found in these common nodules.[65] Further confirmation of such possibilities must depend on multiplying biopsy observations.

It must also be remembered that the researches associated with the study of the apical granulomata have been instrumental in furthering the knowledge of the histogenesis and pathogenesis of certain epithelial odontogenic lesions including radicular cysts, ameloblastoma[31, 47, 68] and associated epidermoid carcinoma of ameloblastic and other types.[2, 12, 64, 66] These contributions established bases for clinical practice now accepted as a matter of course. The data from which hypotheses were drawn and by which they have been confirmed are gained and extended through biopsy in the broader sense of this term.

often identical under disparate circumstances. Syphilis;[3, 4, 27] the excessive use of tobacco, alcoholic beverages and highly seasoned foods;[28] and the presence of ragged teeth;[4, 19, 28] and poorly fitting dentures and the absence of certain teeth[14, 70, 71] must be considered in this connection.

Lichenoid, papillary, discrete, confluent, isolated, diffuse and symmetrical forms present complex features that may be impossible to recognize or interpret clinically.[53] The stage of the process and its general nature are easily ascertained by biopsy. Even though the histology of the lesion is non-specific, the need for



A B

Fig. 9.—Biopsy section from tooth socket (A) made after extraction to eradicate "focus of infection" causing back pain. An immature epidermoid carcinoma was revealed. Roentgen-ray examination of the chest disclosed the primary lesion as pulmonary neoplasm with metastasis to jaw and spinal column. B, necropsy specimen of primary bronchogenic carcinoma.

The Leukokeratoses

Opalescent patches on the mucous membranes of the oral cavity are of frequent occurrence. Their significance or evaluation is at times quite difficult in view of the fact that they have several morphologic variations, may be associated with a wide variety of etiologic agents and are consequently found in heterogeneous clinical settings.

The reaction of buccal, gingival, lingual or palatal mucous membrane is

further observation or treatment can be indicated. (Fig. 5.)

This is especially true of ulcerated, fissured or papillary types. (Fig. 6.) Their malignant potentialities have been well studied[3, 4, 27, 28] and demand biopsy control in any refractory or progressive case. Here, the notable tendency of leukoplakia in syphilis to become established as epidermoid carcinoma earlier and more frequently than other forms must be stressed.[3]

The mucous membrane often undergoes hyperplastic changes in areas adjacent to granulomatous lesions and other inflammatory processes. Elongation of the rete pegs into the infiltrated corium may be followed by snaring off of epithelial islands. If there is any cell atypism or mitosis in such cell groups, their resemblance to carcinoma may confuse those unfamiliar with such variants. This is, therefore, an indirect benefit of frequent biopsy, in that it increases the experience of pathologists concerned with the tissue diagnosis of these lesions.

Epithelial Tumors

epidermoid carcinoma

The etiologic relationship of cancer

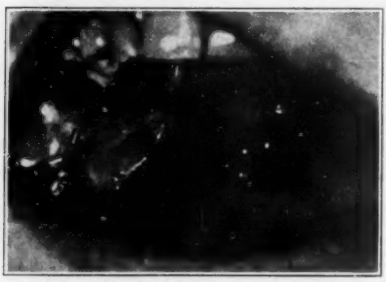


Fig. 10.—A: Circumscribed bulky tumor involving fauces and retromandibular space.

of the oral mucous membrane to the previously discussed granulomata and epithelial disturbances has been well established.[3, 4, 24, 27, 28] Biopsy has been indispensable in following the transitions both histogenetically and clinically. The occasional coexistence of granulomata or leukokeratosis and carcinoma (Fig. 7) cannot be accurately diagnosed in any other manner.[27, 29]

Evaluation of degree of anaplasia has been a recent development of considerable interest to surgical pathologists and radiologists.[11, 18, 25, 26, 61] The ratio of the size of the lesion[11, 55] or its grade of differentiation[11, 18, 25, 26] and the percentage of lymph node metastases have direct clinical bearing on methods of treatment and prognosis. (Fig. 8.)

Aspiration biopsy of questionable nodes to determine the presence of metastasis has been proved useful in many cases.[48] This may be particularly true of a well-known group of highly malignant undifferentiated epidermoid carcinomata of the nasopharynx and tonsils. The tendency of these forms to produce metastasis locally or even of generalized type without tumefaction or notable gross change at the site of origin is a recognized peculiarity of their natural history.[18, 25, 26]

Clinical diagnosis of cervical lympha-

Fig. 10.—B: Adenoma of salivary gland type.

denopathy in such cases may be difficult without the aid of biopsy. If foci of infection in the oral cavity or other dental problems, such as loose teeth, further complicate the clinical setting,[13, 19] diagnosis without biopsy control is impossible and its delay must be regarded as negligence.

Further observation of oral carcinoma during or after treatment may require occasional biopsy of areas suggestive of residual viable neoplastic tissue. Examination of soft tissue adherent to teeth subsequently extracted may reveal car-

cinoma and indicate the need for further treatment.[39]

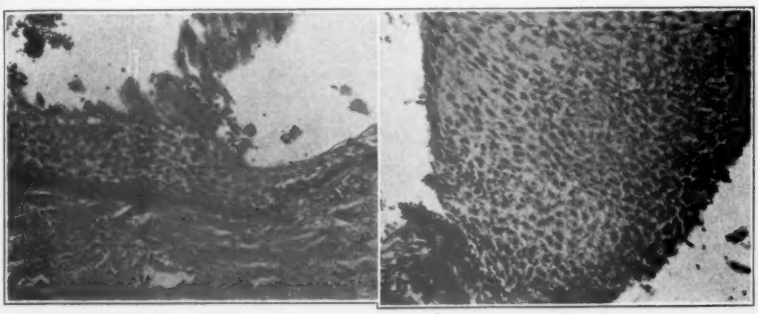
METASTATIC CARCINOMA

Unusual cases with carcinoma metastasizing to the structures of the oral cavity may be confused with primary neoplasms or other disease. The specific histology may direct attention to an unrecognized primary lesion. Asymptomatic *adenoma malignum* of the rectum has been found after metastasis to the jaw was operated on under the clinical impression of abscess. Biopsy of subsequent socket granulations revealed the nature of the process.[8, 42]

This secondary manifestation has also been observed with unrecognized epidermoid carcinoma of the lung metastatic to the spinal column and jaw. Symptoms of radiculitis were attributed to focal infection in the teeth. A tooth with an area of resorption about its apex was extracted. Biopsy of tissue subsequently fungating from the socket showed it to be anaplastic epidermoid carcinoma. (Fig. 9, A.) Further investigation established the lung (Fig. 9, B) as the site of the primary tumor.[39]

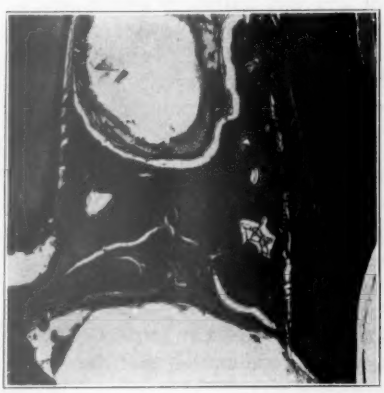
OTHER EPITHELIAL TUMORS

(A) *The Mixed Tumors of the Salivary Glands.*—The mixed tumors of salivary gland type form an important group of tumors involving the oral cavity.[22, 50] Their occurrence in accessory salivary glands in other foci than the parotid, submaxillary or sublingual may make their clinical diagnosis uncertain. (Fig. 10.) Adenoid cystic features are often prominent in a closely related group of epidermoid carcinomata.[19, 24, 25]



A B

Fig. 11.—A and B: Portion of cyst wall, first operation, showing loose reticular type of stratified squamous epithelium (A). Adjacent nodule in alveolar bone removed as special biopsy material, first operation, showing cellular features of stratum intermedium of enamel organ (B).



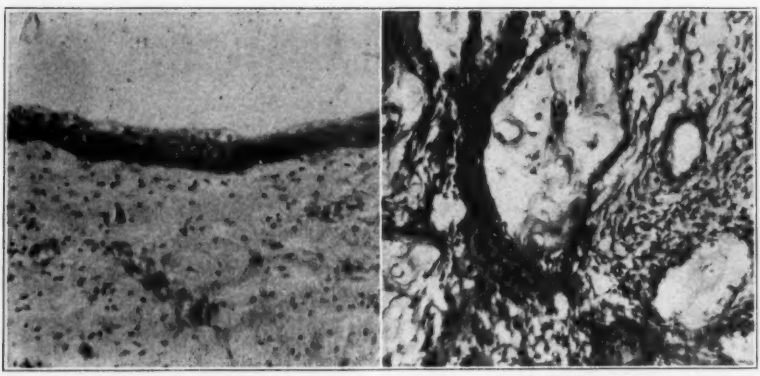
C

Fig. 11.—C: Specimen from second operation one year later for secondary radicular and paradental odontogenic cysts.

The well-known tendency of these neoplasms to recur, even many years after apparently successful operation,

further emphasizes the need for biopsy in any local tumefaction or cervical lymphadenopathy. This is particularly true in those cases with characteristic adenocarcinomatous structure or manifesting rapid growth or aggressive features clinically.[8, 50]

Mucosal cysts and ranula seldom offer serious difficulty of diagnosis. Occasional aberrant tumors of salivary gland type may simulate or suggest such lesions if they are not superficially located.



A B

Fig. 12.—Portion of cyst membrane of ordinary follicular odontogenic variety (A). Adjacent area with features of atypical ameloblastoma (B). Recurrence eighteen years later required a second operation and radiotherapy.

(B) *Odontogenic Cysts.*—The concept of biopsy must be applied to a large and important group of epithelial disturbances of odontogenic origin even though this may be at slight variance from the accustomed usage of the term. Marsupialization leaving a portion of the wall *in situ* depends on tissue examination to support its assumption that the lesion is of ordinary type. This presupposes further guidance in instances of unusual epithelial characters of atypical or ameloblastic features.[12, 15, 64]

Complete examination is essential in view of the focal histologic variation of the tissue, which may present simple stratified epithelium in one area (Fig. 11, A), an ameloblastic type in another (Fig. 11, B) and a classical ameloblastomatous structure in a third. Local recurrence (Fig. 11, C), the development of secondary cysts,[39] ameloblastoma or even ameloblastic carcinoma[2, 12, 66] may be explained on the basis of such irregularities.[2, 12, 39, 66]

The occasional ameloblastic nature of apparently simple radicular cysts may be revealed.[44] Dentigerous or follicular (Fig. 12) paradental cysts can be especially notable for ameloblastic trend.[12, 15, 32, 39] Nodules of papilliferous

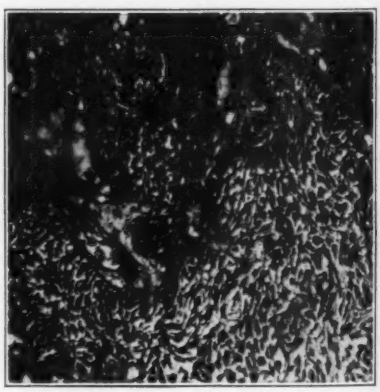


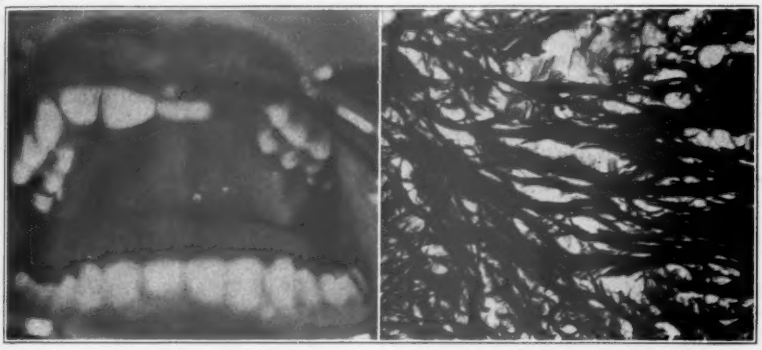
Fig. 13.—Cellular atypical ameloblastoma; features of types with locally aggressive or potentially malignant form.

tendency may present many of the features regularly associated with ameloblastoma[12] and give evidence of invasion of adjacent structures.[64] Subsequent development of ameloblastoma[12] and epidermoid carcinoma[2, 58, 66] has been reported.

Cysts of the nasopalatine canal form

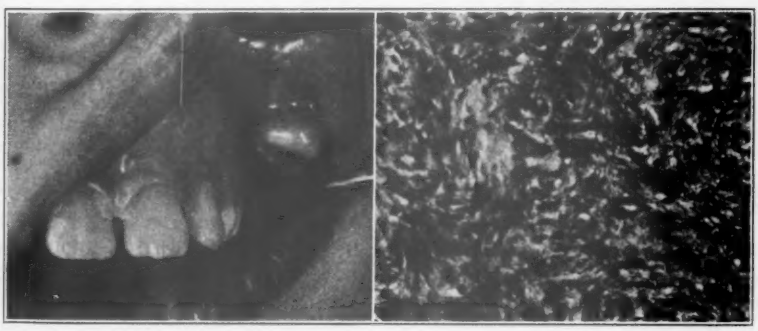
droma, as well as the more common odontogenic cysts. Examination of tissue may be considered as in the nature of a biopsy in the broader sense previously discussed. This is especially the case in the study of tissue adjacent to the tumor.[12, 15, 32, 39, 63, 64, 68]

The aggressive, poorly differentiated,



A B

Fig. 14.—Circumscribed tumor implicating fauces and alveolar ridge. The resemblance to salivary adenoma (compare Fig. 10 A) should be noted (A). B, benign fibroma revealed on biopsy.



A B

Fig. 15.—Circumscribed tumor of sulcus (A); cellular fibroma (B). This lesion is of potentially aggressive or malignant form (compare Fig. 14 B).

a separate group to be differentiated from those of odontogenic origin.[6]

(C) *Ameloblastoma.*—Tumors of this type may present clinical and roentgenographic evidence similar to that of myxoma, central benign giant-cell tumor, fibroma, immature odontoma and chon-

potentially carcinomatous forms (Fig. 13) should be mentioned as possibilities to be evaluated through biopsy.[15, 24, 45, 63, 66] The indication for further observation or postoperative irradiation as well as subsequent biopsy to determine questions of recurrence must also be emphasized.

(D) *Hypertrophies.*—Both epithelial and connective tissues are implicated in hyperplasia of the gingival, palatal and buccal mucous membranes and the lips. (Fig. 6, A, B.) The clinical features may suggest neoplasm.[19] Their inflammatory, productive nature is evident on histologic examination. Polypoid excrescences from the antrum protruding through tooth sockets are of similar nature.[36]

NON-EPITHELIAL TUMORS

Angiomata of lymphatics and blood vessels are of frequent occurrence about the floor of the mouth and the gingival surface.[19, 34] Their differentiation from telangiectatic granulomata may be difficult. Histologic criteria may also be obscured in ulcerated secondarily infected lesions. The chief value in biopsy is to ascertain, if possible, whether the lesion is neoplastic and to determine its classification and degree of organoid development in view of the unfavorable prognosis of angioendotheliomatous types.[34]

Fig. 16.—Fragment of underlying myxoma adherent to extracted tooth.

Fibromata may resemble mixed tumors of salivary gland origin, particularly in those instances in which they form bulky masses on the palate. (Fig. 14.) The occasional cellular forms may present atypical features (Fig. 15) and suggest the need for continued postoperative observation for recurrence.[32] Myoblastoma may be simulated both clinically and histologically.[39]

Giant-cell epulides, ordinarily completely excised or treated with radiotherapy after biopsy, may have far-reaching significance. (Fig. 18, A.) Their relationship to centrally placed osteoclastomata may be an expression of *osteitis fibrosa cystica* due to hyperparathyroidism. Under such circumstances, they should direct further investigation to determine this possibility. The local process in the jaws may be the first indication of a serious constitutional disease. (Fig. 18, B, C, D.) The oral surgeon may play an important part in its recognition through biopsy.[1, 10, 16, 23, 37, 38, 40, 48, 52, 57, 67]

The recurrence or persistence of a local central giant-cell tumor may require the confirmation of biopsy to establish the benign nature of the process.[24, 38]

DISEASES OF BONE

(A) INFLAMMATION

Specific granulomatous processes, including gumma; actinomycosis; the plasma cell granulomata of the maxilla, nose or pharynx, and the xanthomata of lipoid histiocytosis of the Schüller-Christian type may affect the maxillae and mandible. Here, they present diagnostic problems of even greater difficulty than when they involve the soft tissues.

The rarefying and sclerosing types of osteitis of the maxillae or mandible may cause tumefaction. Their roentgenographic features can further simulate neoplasm of either osteolytic or osteoblastic types.[8, 30, 32, 51, 62] Biopsy can indicate their inflammatory basis and guide surgical intervention to conservative measures.[30]

Osteomyelitis of suppurative, granulating and condensing types presents variable clinical and roentgenographic features. Periosteal forms may resemble fibromata of ossifying type or even osteogenic sarcoma.[32, 62] Bone abscess can simulate granulomata or cysts.[62]

Necroses of the jaw due to contact with phosphorus or radium are special cases in this group.[5] Although osteogenic sarcoma following radium poisoning more commonly affects other bones, jaw lesions must be recognized as a possibility.[49] Sequestra are natural biopsy material and deserve examination.

Tissues adhering to extracted teeth may give indication of underlying or adjacent inflammatory, dystrophic or neoplastic (Fig. 16) disease of bone. The loosening of a tooth is a frequent manifestation of the widest variety of pathologic lesions of the jaws.[1, 7, 8, 10, 13, 19, 32, 37, 38, 58]

A

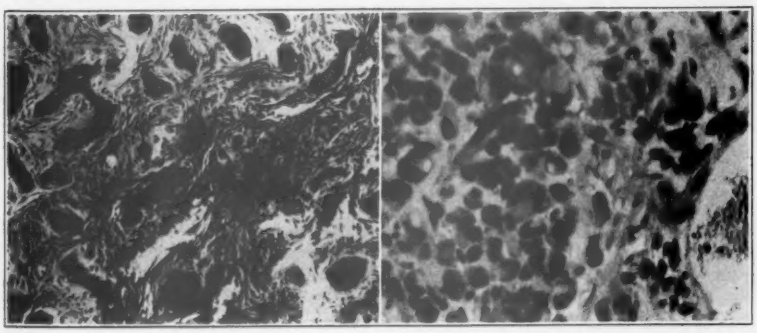
Fig. 17.—Tumefaction involving palate.

Biopsy should be made on tissue removed from a sluggishly healing socket in order to reassure the surgeon.

Traumatic hematomata as noted in *osteitis cystica hemorrhagica* may have clinical and roentgenographic similarity to odontogenic and other cystic disease of the jaw.[9, 62] Biopsy of their walls reveals their histologic characteristics.

Central giant-cell tumors of isolated type are a separate group of different implication and origin from the giant-cell epulides. Their clinical diagnosis is also more uncertain.[32, 38, 62, 63] Biopsy is particularly indicated in these cases. Recurrent lesions should have the same biopsy control as the simple epulis.

Osteitis fibrosa of localized type may present difficulties of diagnosis to the clinician and of interpretation to the pathologist. (Fig. 17, A, B.) Cooperation is essential. Its neglect may be the cause of misunderstanding and confusion. The biopsy is here only one factor in the problem, although it may guide further clinical action. Atypical forms of the lesion may be followed by osteogenic sarcoma (Fig. 17, C) as indicated by further biopsy.[24, 39]



B C

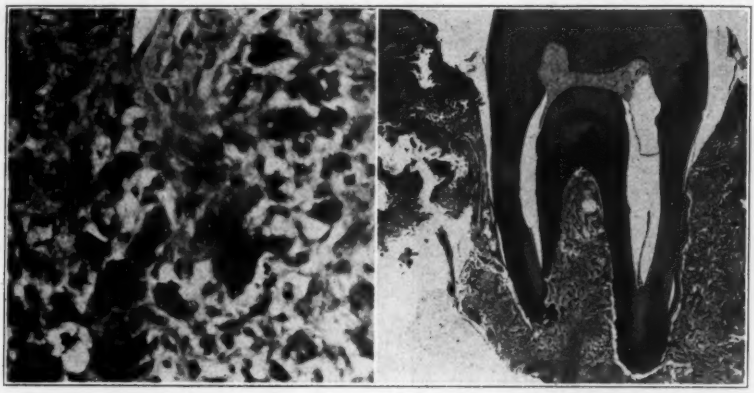
Fig. 17.—B and C: Cellular osteitis fibrosa localisata (B); malignant undifferentiated osteolytic sarcoma developing after eight years (C).

(B) DYSTROPHIC DISEASE OF BONE

Osteitis fibrosa generalisata frequently manifests itself in the jaws. Loosening of

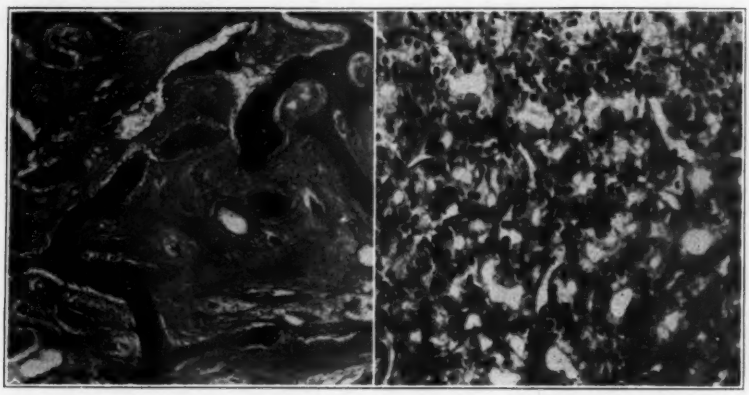
teeth[10] and the formation of giant-cell epulides[1, 23, 37, 38, 40, 52, 67] and giant-cell tumors[1, 16, 37, 38, 43, 57] are typical of the dental background of the disease. (Fig. 18.) The gingivitis present under these circumstances may be considered the cause of alveolar resorption; whereas it is actually an effect.[10] Biopsy diagnosis should establish clinical investigation for hyperparathyroidism.[37, 38]

Osteitis deformans does not ordinarily require biopsy for its diagnosis. However, the cases with reactive disease, finally expressing itself as osteogenic sarcoma, require tissue examination for confirmation and treatment. This is a



A B

Fig. 18.—A and B.: Biopsy section from lesion simulating epulis clinically showing giant cell structure (A). Rarefaction, revealed by roentgen-ray examination, indicating further tissue removal. B, operative specimen showing trabecular resorption and fibrosis.



C D

Fig. 18.—C and D: High power field of Figure 18 B with features of osteitis fibrosa (C). Further clinical investigation disclosed hyperparathyroidism and a generalized process. Removal of adenoma of parathyroid gland (D) was followed by spontaneous healing of lesions in jaw and other bones.

prominent feature of Paget's disease, particularly when involving the skull.[17]

(c) NEOPLASTIC DISEASE OF BONE

Fibromata are differentiated with difficulty from productive and granulating forms of osteitis. They may require biopsy not only for diagnosis, but also to ascertain whether they present unusual histologic features indicative of potential aggressive or malignant recurrence.[32]

Ossifying fibroma or osteoma may often appear to be a healing stage of osteitis.[30, 32, 62] Differentiation on histologic bases may also be uncertain. Here, again, a combined approach to interpretation is indicated.

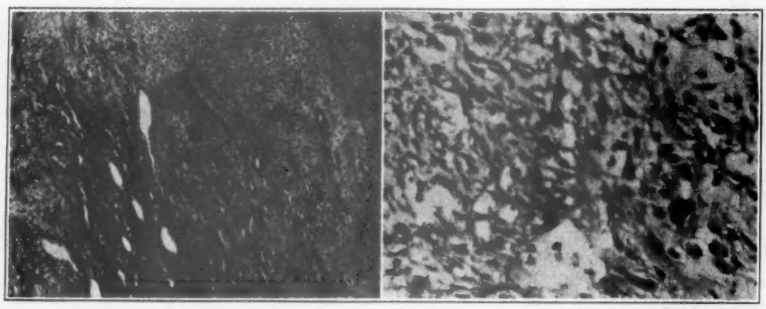
Myxomata are unusual tumors of the jaws. They may be occasionally of immature odontomatous type. (Fig. 16.) Roentgenographic criteria are indefinite. The possibility of recurrence or malignant transformation must be recognized.[35]

The mature odontoma usually presents characteristic roentgenographic features. Cases with a high percentage of epithelial elements capable of ameloblastomatous or carcinomatous trend can be evaluated only through biopsy. The cellular undifferentiated mesenchyme may also become the focus of sarcomatous change requiring tissue examination.[63]

Osteochondroma and chondrosarcoma (Fig. 19 A) do not permit accurate clinical diagnosis.[8, 33, 63] The unfavorable prognosis and need for special observation and treatment must depend on biopsy.[32, 33, 54, 58]

Osteogenic sarcoma of the skull in *osteitis deformans* has already been considered. Rapidly progressing types in younger subjects form an entirely different group. (Fig. 19, B.)

Sclerosing osteogenic sarcoma involves the jaws most frequently after the long bones.[46] The acute course, with pain, swelling, leukocytosis and a rise in temperature, along with poorly defined roentgenographic changes in the early stages, makes the clinical diagnosis of osteomyelitis almost inevitable.[24, 46] The loosening of teeth may also be confusing. Biopsy is required for interpretation of the disease process.[54] Osteolytic forms of osteogenic sarcoma are less frequent but present similar problems.[32, 33, 54, 62]



A B

Fig. 19.—Chondrofibrosarcoma (A) and osteolytic osteogenic sarcoma (B). The lesions showed similar rarefaction roentgenographically.

CONCLUSION

Biopsy is a useful and valuable procedure in oral surgery.

Neoplasms, specific infectious diseases, inflammatory processes and local expressions of general disease are often dependent on biopsy when clinical, roentgenographic, serologic or chemical

data are indeterminate or conflicting and differential diagnosis is uncertain.

Further investigation, treatment and prognosis may be suggested through tissue examination.

The natural history of important diseases of the oral cavity and their tendency to a progressive course or complex changes make biopsy especially necessary.

Advances in the understanding of the histogenesis and pathogenesis of many lesions affecting the mouth and jaws have utilized biopsy for fundamental information, a practice which should be further extended.

The more frequent use of biopsy can be expected to clarify many otherwise obscure clinical syndromes and strengthen the position of the oral surgeon in his approach to his problems.

Active cooperation between the oral surgeon and the pathologist is essential.

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Editorial Department

DEVELOPING GREATER RESPONSIBILITY AMONG THE STUDENTS OF OUR DENTAL SCHOOLS

THE problem of properly training students for the practice of a profession is a manifold one. It is not enough that the students shall be taught the technics of the various subjects. Of course, in a profession like dentistry, there is no question of the manifest necessity for the highest possible development of technical training. Without this, the practitioner of dentistry makes an unfortunate spectacle of himself. But technical training is by no means sufficient. The most expert jeweler in the world would not necessarily make a good dentist. A certain something is required of a dental student in addition to the technical and mechanical skill incident to constructing a piece of jewelry. Recognition of the problems involved in health and disease as affected by the results achieved in our efforts to serve our patients through the medium of appliances and instruments is at all times necessary and at every turn of our endeavor.

Unless we recognize this fact we shall fall far short of properly training dental students.

It has repeatedly been said that to make an acceptable dentist requires a wider range and a higher order of ability than that demanded of almost any other occupation. This fact should be recognized not only by members of the profession, but especially by the students in the dental schools. And it is a "large order" for any dental student.

Among the various types of instruction meted out to the student in a dental school, one of the most important is seldom even mentioned in a college curriculum. The end and aim of undergraduate training seems to resolve itself into a concentration on the scientific and technical phases of student development. This is, of course, perfectly natural and quite in keeping with the manifest necessities of the case, but it is after all a far cry from perfection in these essentials to the comprehensive and completely rounded out course that should be given students in a dental school.

If the real object of training our students is to make better dentists, as we think it should be, we have been almost entirely remiss in one of the chief essentials of this particular problem. At almost every stage in conducting a practice, the dentist is confronted with the responsibility of exercising his judgment in various and sundry ways, and unless he is schooled to do this as a student, he enters practice handicapped in one of the essentials.

The problem, then, of all others is to develop in the mind of the student a sense of his responsibility toward the people he is destined to serve. The mark of a professional man of a higher order is embodied in the salutary influence which he exerts over every person who comes under his care, and no student can ever develop an ability along these lines without having the idea ingrained in him during his training period.

The student should early be taught to assume responsibility and to cultivate a vision of his real relationship to other members of his profession and to humanity at large. Above all things, he should be made to feel his obligation to the particular individuals who are committed to his care, and to take a vital and intimate interest in their welfare. The practice of dentistry is hedged about by all sorts of difficulties and responsibilities; and unless the student is taught to realize this, he will cut a sorry figure when he faces the real emergencies of his daily life. In short, the training of a dental student is a serious business, and it should be so regarded by every teacher in our schools.

DENTAL HEALTH SERVICE IN THE ARMY

In the passing of the legislative enactment increasing the Army Dental Corps and providing for the rank of Brigadier General for the head of the Corps (see page 473), the legislative branches of the Government have accorded to the dental profession recognition of the importance of dentistry as a branch of the health service of the Army of which we have every reason to be proud.

A brief historical account of the origin and development of the Dental Corps makes the record of accomplishment all the more impressive.

For nearly a half century before dentistry was established as a factor of the governmental health service, the profession had made almost continuous effort to secure the opportunity to demonstrate the value of the service which it was capable of rendering to those engaged in the defensive work of the nation. In 1901, Congress finally acceded to the demands of dentistry and provided dental service in the Army on a contract basis. Acceptance of the service on such basis was viewed with much misgiving, not to say alarm, by the leaders of the profession. However, impelled by the spirit of humanitarianism and duly impressed with the humbleness of the newly acquired status, the profession set about its task of building the foundation for a corps that would compel fuller recognition of its value as a health service.

While the status thus accorded to dentistry in the government service was neither dignified nor commensurate with its professional position, nor in keeping with the character of service which dentistry was capable of rendering, the leading minds of the profession of that day advocated the acceptance of the status offered on the ground and in the hope that it would enable dentistry to demonstrate in a practical manner that its service was something larger and more important than was at that time recognized by the government, and that if the dental profession fairly and fully utilized the limited opportunity presented, the essential usefulness and larger possibilities of its service would in time be appreciated at their intrinsic value and be duly recognized.

And that is exactly what happened. The objectionable contract feature was later eliminated and dental surgeons were given a rank and dignity more in accord with their professional standing. The evolution of the dental profession since that time has re-created dental ideals and re-oriented the point of view and estimate of the dental field of activity both within and without the dental profession.

The experience of the World War abundantly proved the necessity

for healthy mouths and teeth as insurance against bodily disease. The military medical records of all nations furnish convincing evidence of the direct relationship between sound teeth and the physical efficiency of the fighting men. Our Government practically recognized that fact in the creation and equipment of the largest and most efficient army and navy dental service of any of the belligerent nations and further emphasized its recognition of the vital importance of mouth health by providing for the instruction of its military forces in the personal hygienic care of the mouth.

In 1911, as a result of the efforts of the profession expressed through the conscientious labors of the then humble group of pioneers in army dental service, the Dental Corps was established on a commission basis. And again in 1917, as a result of the lesson taught by the unfortunate experiences of the European countries through lack of dental service in the armies taking part in the World War, and but a short while prior to our entrance into the war, further recognition of the value of dental service to the army was evidenced by granting increased rank to the Dental Corps.

Dentistry then was given, for the first time in its history, the ample opportunity to prove its claims as one of the most important branches of the healing art, and the manner in which it responded is a matter of historical record that is a source of gratification to all. The Dental Corps during the trying years of the world's most serious conflict gladly and eagerly took up its task and proved beyond question the wisdom of the Government in establishing the Dental Corps on a similar basis to that of the Medical Corps.

The Surgeon General, whose favorable attitude toward the Dental Corps materially forwarded the present legislation, a short time after its passage, remarked that the dental profession was to be congratulated upon attaining in a few years a military status that had required the unceasing efforts of the medical profession for almost a hundred years. And while much of the credit for our accomplishment goes to the character of the services rendered by the pioneer contract dentists and the admirable record of our corps in the World War, the pioneer work of the Medical Corps and the appreciation by the heads of the Medical Corps, particularly Surgeon-General Reynolds, of the character of dental health service that is being rendered to the Army, were most influential factors.

The Legislative Committee of the American Dental Association under the able direction of its Chairman, Dr. A. B. Patterson and Vice-Chairman, Dr. Charles D. Cole, and with the whole-hearted support of the

President, Dr. C. Willard Camalier, and the able championship of our cause by Senator Sheppard of Texas, and Congressmen Collins of Mississippi, May of Kentucky, and Harter of Ohio, sponsors of the Bill, has done a great good for dentistry and deserves and receives the unstinted praise of the profession for a distinguished service.

But the end is not yet. While we have attained much and are proud of our record, further responsibilities, obligations and opportunities in the field of public health are developing upon dentistry's broadening horizon. We recognize these responsibilities and obligations and await with eagerness the opportunity to prove further our ability to help in the solution of the problems of preventive medicine related to the dental field.

L. P. A.

NATIONAL DENTAL HEALTH POSTER CONTEST

EVERY worthwhile project needs a motif and a motor.

The motif of the American Dental Association's 1938 project is "Dental Health for American Youth."

The motor is the National Dental Health Poster Contest.

The energetic and enthusiastic manner in which the state and component societies are promoting this contest is remarkable.

To date, thirty-three states in whole or in part have entered the contest.

The contest is so arranged that children in the rural schools have an equal chance with children in the city schools.

It offers dentists and teachers an opportunity to drive home the message of preventive dentistry.

Over 70,000 reprints of the poster rules have been distributed. This means that 70,000 schools have been contacted and that the children in those schools, as well as their teachers and parents, are being made to think of their teeth.

The winning posters from each state will be sent to the divisional state and national contests; the others will remain at home where teachers will use them for future dental health lessons.

From present reports, this poster contest will be the largest one of its kind ever conducted in the world.

Its success will be limited only by the amount of cooperation received by the state and the component poster committees.

ASSOCIATION ACTIVITIES

COMMITTEE ON LEGISLATION

SEVENTY-FIFTH CONGRESS OF THE UNITED STATES OF AMERICA;

AT THE THIRD SESSION,

Begun and held at the City of Washington on Monday, the third day of January, one thousand nine hundred and thirty-eight.

AN ACT

To authorize an additional number of medical and dental officers for the Army.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 10 of the Act entitled "An Act for making further and more effectual provisions for the national defense, and for other purposes," approved June 3, 1916, be amended by providing that on and after July 1, 1937, there shall be officers as now authorized by law, except that there shall be four assistants to the Surgeon General with the rank of brigadier general, one of whom shall be an officer in the Dental Corps, ... and two hundred and fifty-eight officers of the Dental Corps, and the authorized commissioned strength of the Army is hereby increased . . . . . in order to provide for the increases herein authorized in the . . . . . Dental Corps.

SEC. 2. That the Act entitled "An Act to authorize officers of the Medical Corps to count certain service in computing their rights in retirement, and for other purposes," approved May 29, 1928, be amended by adding at the end thereof "service as Contract Dental Surgeons and Acting Dental Surgeons shall be credited to the officers of the Dental Corps for the purpose of retirement."

THE above Act was adopted by the Senate January 15, concurred in by the House of Representatives January 24, and signed by the President on January 31, 1938.

The original bill, endorsed by the American Dental Association and entered in the House of Representatives by Congressman Ross A. Collins of Mississippi, was amended again and again, emerging after many difficulties as above, vigorously championed by Senator Morris Sheppard of Texas, Congressman Andrew J. May of Kentucky, chairmen respectively of the Senate and House Committee on Military Affairs, and Congressman Dow W. Harter of Ohio, chairman of the Sub-Committee on Military Affairs of the House.

To these four gentlemen in particular, although many members of both Houses gave invaluable support, we are indebted as a profession for the successful conclusion of this two year effort on the part of the Committee on Legislation, to secure for the Army at least a minimum of adequate dental service properly administered.

The addition of one hundred dental officers to the personnel of this corps will

greatly improve this service, with resultant benefit to the health and efficiency of the rank and file of the army.

The signal honor accorded the dental profession in this official recognition by Congress and the President of the value of dental service, with the granting of the rank of Brigadier General to the chief of the army dental service, enhances tremendously the prestige of the dental profession, and its status in the eyes of the public will be further improved.

The Committee on Legislation takes this occasion to express appreciation to those officers and members of the American Dental Association and its state components, who aided so materially in this effort to bring to the attention of Congress, the immediate need for improvement in army dental service.

A. B. PATTERSON, *Chairman,*
CHARLES D. COLE, *Vice-Chairman,*
Committee on Legislation,
American Dental Association.

MAIL ORDER DENTURES DECLARED FRAUDULENT

The United States Post Office Department, under date of February 21st, issued a fraud order against S. B. Heininger of Chicago, which prohibits his use of the mails.

NATIONAL BOARD OF DENTAL EXAMINERS

THE tenth session of the National Board of Dental Examiners was held December 3 and 4, 1937, in the following cities, in the schools and under the supervision of the dentists listed:

Cities	Schools	Supervisors
Atlanta, Ga.	Atlanta-Southern Dental College	M. M. Forbes
Baltimore, Md.	Baltimore College of Dental Surgery	B. Lucien Brun
		Ethelbert Lovett
Boston, Mass.	Tufts College	W. Henry Grant
		Harold Alden
Chicago, Ill.	Northwestern University	W. Ira Williams
		Clyde H. Warner
Iowa City, Iowa	State University of Iowa	John V. Conzett
Memphis, Tenn.	University of Tennessee	E. W. Taylor
		B. C. Gallimore
New Orleans, La.	Loyola University	Fred J. Wolfe
New York City	Columbia University	Frank E. Beube
Philadelphia, Pa.	University of Pennsylvania	Alexander Reynolds
		M. F. Quinn
Pittsburgh, Pa.	University of Pittsburgh	W. A. McCready
Richmond, Va.	Medical College of Virginia	John M. Hughes
		Hugh G. Russell

RESEARCH COMMISSION

LIST OF CERTIFIED PRODUCTS, 1937

A revised list of dental materials which have been certified to the Research Commission by the respective manufacturers as complying with American Dental Association specifications is given below. This list will be revised as new certifications are received or as materials are checked for compliance with specifications.

Samples of all amalgam alloys, inlay casting investments, impression compounds, inlay casting waxes, inlay casting gold alloys, dental mercury and zinc phosphate cements certified to the Research Commission of the American Dental Association by the various manufacturers as listed herein were procured in the open market by the Research Commission and tested by the A.D.A. Research Associates at the National Bureau of Standards. As of January 1, 1938, the following listed materials were found to comply with American Dental Association Specifications. Certified materials which did not comply are omitted from this list.

CERTIFIED AMALGAM ALLOYS A.D.A. SPECIFICATION NO. 1[1]

FOURTH SURVEY OF ALLOYS

(May 4, 1935)

Alloy	Manufacturer or Distributor
Accurate Metalloy (filings)	The L. D. Caulk Co.
Ackerman (filings)	Ackerman Dental Mfg. Co.
Argentum (shavings)	Hammond Dental Mfg. Co.
Argentum (filings "A" cut)	
Argentum (filings, medium cut)	
Argentum (filings, fine cut)	
Aristaloy	Baker & Co., Inc.
Banner (filings)	Goldsmith Bros. S. & R. Co.
Blue Diamond (filings)	Reliance Dental Mfg. Co.
Brewster Medium (shavings)	E. R. S. Brewster
Brewster Quick (filings)	
Brewster Quick (shavings)	
Capeako (filings)	Precious Metals Refining Works
Certified	Lee S. Smith & Son Mfg. Co.
Coe	Coe Laboratories, Inc.
Cresilver	Crescent Dental Mfg. Co.
Diamond Edge	Young-Baker & Co.
Dee (filings)	Thomas J. Dee & Co.
Excel	Daniels Dental Alloy Co.
Fellowship (filings) (medium setting)	The Dental Protective Supply Co.

1. PAFFENBARGER, G. C., and SWEENEY, W. T.: Specifications and Certifications for Dental Materials. J.A.D.A., 21:658, April 1934.

Minimax (filings) (shavings) 172 173 173 177 174 178 177 180 178 161 180 181 183 161 Minimax White Gold & Platinum	The Minimax Co.
Mission No. 5 Mission No. 5 "A" cut Mission No. 6	Henry F. Bruce Co., formerly San Diego Smelting & Refining Co.
Modeloy (Quick Setting) (filings)	Crescent Dental Mfg. Co.
Ney-Aloy Ney-Aloy No. 125	The J. M. Ney Co.
Odontographic "Improved" (filings)	Odontographic Mfg. Co.
Preferred D Preferred C	Precious Metals Refining Works
Research Oralloy	Precious Metals Research Works, Inc.
Royal-Special First Setting	Garhart Dental Specialty Co.
Silver Crown	General Refineries, Inc.
Silverloy (filings and shavings)	Crescent Dental Mfg. Co.
Speyer	Speyer Smelting & Refining Co.
S-C Medium (filings) S-C Quick (filings)	Stratford-Cookson Co.
True Dentalloy (filings) True Dentalloy (cut A)	The S. S. White Dental Mfg. Co.
Twentieth Century (filings)	The L. D. Caulk Co.
White Beauty	Land Dental Mfg. Co.

Certified Inlay Casting Investments A.D.A. Specification No. 2[2]

Second Survey of Investments

(June 24, 1935)

Investment	Manufacturer or Distributor
Coecal Inlay Coecal Universal	Coe Laboratories, Inc.
Kerr Cristobalite-Inlay Kerr No. 3	Detroit Dental Mfg. Co.
Ransom and Randolph Gray Ransom and Randolph Green Ransom and Randolph X-45	The Ransom & Randolph Co.
S. S. White Inlay No. 20	The S. S. White Dental Mfg. Co.
Security Improved Inlay	The Cleveland Dental Mfg. Co.

2. Taylor, N. O.; Paffenbarger, G. C., and Sweeney, W. T.: Dental Inlay Casting Investments: Physical Properties and Specification. J.A.D.A., 17:2266, December 1930.

Certified Impression Compounds A.D.A. Specification No. 3[3]

Third Survey of Impression Compounds

(August 1, 1935)

Compound	Manufacturer or Distributor
Brewster	E. R. S. Brewster
Certified	Lee S. Smith & Son Mfg. Co.
Dresch	The Ransom and Randolph Co.
Kerr Black	Detroit Dental Mfg. Co.
Kerr No. 3	Detroit Dental Mfg. Co.
Kerr Perfection	Detroit Dental Mfg. Co.
Kerr White	Detroit Dental Mfg. Co.
Mizzy-Low Heat	Mizzy, Inc.
Moyer	The J. Bird Moyer Co.
S. S. White-Black-Tray	The S. S. White Dental Mfg. Co.

Certified Inlay Casting Waxes A.D.A. Specification No. 4[4]

Third Survey of Inlay Waxes

(August 1, 1935)

Wax	Manufacturer or Distributor
Brewster	E. R. S. Brewster
Caulk-Blue	L. D. Caulk Company
Kerr-Blue-Hard	Detroit Dental Mfg. Co.
Maves	The Heidbrink Co.
Peck's Blue	A. E. Peck Mfg. Co.
Security	The Cleveland Dental Mfg. Co.
Sterling	Baker & Co., Inc.

Certified Inlay Casting Gold Alloys A.D.A. Specification No. 5[5]

Second Survey of Inlay Casting Gold Alloys

(February 15, 1937)

Alloy	Type*	Manufacturer or Distributor
Aderer-A-Soft	A	Julius Aderer, Inc.
Aderer-B-Medium	B	Julius Aderer, Inc.
Aderer-C-Hard	C	Julius Aderer, Inc.
Baker-Inlay-Soft	A	Baker & Co., Inc.
Baker-Inlay-Medium	B	Baker & Co., Inc.
Chilcast No. 1	A	Vernon-Benshoff Co.
Chilcast No. 1-A	B	Vernon-Benshoff Co.
Chilcast No. 2	C	Vernon-Benshoff Co.
Chilcast No. 2-A	B and C	Vernon-Benshoff Co.
Crown-Do-All Casting	C	General Refineries, Inc.
Crown Inlay No. 2-Soft	A	General Refineries, Inc.
Crown Inlay No. 1 Hard	B	General Refineries, Inc.
Crown Inlay No. 9	C	General Refineries, Inc.
Crown K	A	General Refineries, Inc.
Crown Knapp No. 2	B	General Refineries, Inc.
Crown Knapp No. 3	B	General Refineries, Inc.
Crown T	B	General Refineries, Inc.
Crown TT	C	General Refineries, Inc.

3. Taylor, N. O.; Sweeney, W. T., and Paffenbarger, G. C.: Specification for Dental Impression Compounds. J.A.D.A., 18:53, January 1931.

4. Taylor, N. O.; Paffenbarger, G. C., and Sweeney, W. T.: Specification for Inlay Casting Wax. J.A.D.A., 18:40, January 1931.

Deetwo Light	A	Thomas J. Dee & Co.
Deetwo	B	
Dressel	C	Julius Aderer, Inc.
Goldsmith Inlay No. 1	A	Goldsmith Bros. S. & R. Co.
Goldsmith Inlay No. 2-Medium	B	
Goldsmith Inlay No. 3-Hard	C	
Jelenko Alboro Inlay	C	J. F. Jelenko & Co., Inc.
Jelenko Durocast	C	
Jelenko Firmilay	C	
Jelenko Modulay	B	
Jelenko Platin-Cast	B	
Jelenko Special Inlay	A	
Ney-Oro A	A	The J. M. Ney Co.
Ney-Oro A-1	B	
Ney Oro A-10	B	
Ney-Oro B	C	
Ney Oro B-2	C	
Research-A-Soft	A	Precious Metals Research Works, Inc.
Research-B-Medium	B	
Research Inlay	C	
Research-Hard Cast No. 5	C	
Sypco Hard	B	Spyco Smelting and Refining Co.
Spyco Soft	A	
Sypco No. 6	C	
S. S. White No. 1	B	The S. S. White Dental Mfg. Co.
S. S. White No. 2	A	
S. S. White No. 13	C	
S. S. White No. 31 Metalba	B	
S. S. White No. 820	B and C	
S. S. White No. 940	A	
Stern No. 2847	C	I. Stern and Co.
Stern No. 3290	B	
Stern No. 3337	C	
Stern No. 3375	A	
Stern No. 3441	C	
Stern No. 3465	B and C	
Tinker No. 1	B	Spyco Smelting and Refining Co.
Tinker No. 1H	C	
Tinker No. 2	C	
Tinker Inlay	B	

*Relative hardness: A, soft; B, medium; C, hard.

Certified Dental Mercuries A.D.A. Specification No. 6[6]

Second Survey of Mercury
(February 2, 1937)

Mercury	Manufacturer or Distributor
Argentum	Hammond Dental Mfg. Co.
Chemically Pure	The S. S. White Dental Mfg. Co.
Dee	Thomas J. Dee & Co.
Dental	Goldsmith Bros. S. & R. Co.
Mercury Laboratories	Mercury Laboratories, Inc.

5. Taylor, N. O.: Paffenbarger, G. C., and Sweeney, W. T.: Inlay Casting Golds: Physical Properties and Specifications. J.A.D.A., 19:36, January 1932.

Minimax	The Minimax Co.
Mission	Henry F. Bruce Co., formerly San Diego Smelting & Refining Co.
Mynol	Mynol Chemical Co.
Ney's C. P.	The J. M. Ney Co.
Odontographic	Odontographic Mfg. Co.
Positively Pure	Garhart Dental Specialty Co.
R. P. C.	Research Products Corporation
Spectropure	Baker & Co., Inc.
Twentieth Century	The L. D. Caulk Co.

Certified Wrought Gold Wire Alloys A.D.A. Specification No. 7[7]

Second Survey of Wrought Gold Wire Alloys
(September 4, 1937)

Alloy	Manufacturer or Distributor
Aderer No. 1	Julius Aderer, Inc.
Aderer No. 3	Julius Aderer, Inc.
Aderer No. 4	Julius Aderer, Inc.
Aderer No. 20 Clasp	Baker & Co., Inc.
Baker Q-A	Baker & Co., Inc.
Deepep-Hard	Thomas J. Dee & Co.
High Fusing Clasp	Goldsmith Bros. S. & R. Co.
Jelenko No. 3 Clasp	J. F. Jelenko & Co., Inc.
Jelenko Super	J. F. Jelenko & Co., Inc.
Medium Clasp	Goldsmith Bros. S. & R. Co.
Ney-Oro Elastic No. 2	The J. M. Ney Co.
Ney-Oro Elastic No. 4	The J. M. Ney Co.
Neydium 9	The J. M. Ney Co.
Regular Clasp	Goldsmith Bros. S. & R. Co.
Spyco No. 3	Spyco Smelting and Refining Co.
Stern No. 2657	I. Stern and Co., Inc.

Certified Zinc Phosphate Cements A.D.A. Specification No. 8[8]

Cement	Manufacturer or Distributor
Ames Z-M	The W. V-B. Ames Co.
Caulk, Crown & Bridge	The L. D. Caulk Co.
Caulk, Petroid Improved	The L. D. Caulk Co.
Caulk, Tenacin	The L. D. Caulk Co.
Fleck	The J. R. Stanley Chemical Co.
Lang	Lang Dental Mfg. Co.
Smith	Lee S. Smith & Son Mfg. Co.
S. S. White, Zinc	The S. S. White Dental Mfg. Co.
S-C	Stratford-Cookson Co.

6. Isaacs, Aaron: Mercury for Dental Amalgams. J.A.D.A., 19:54, January 1932.

7. Paffenbarger, G. C.; Sweeney, W. T., and Isaacs, Aaron: Wrought Gold Wire Alloys: Physical Properties and Specification. J.A.D.A., 19:2061, December 1932.

8. Paffenbarger, G. C.; Sweeney, W. T., and Isaacs, Aaron: Zinc Phosphate Cements: Physical Properties and Specifications. J.A.D.A., 21:1907, November 1934.

BUREAU OF PUBLIC RELATIONS

PREVALENCE OF ACTIVE UNTREATED DENTAL CARIES BY SINGLE AGES

By Charles F. Deatherage,* D.D.S., Springfield, Ill.

THIS report comprises information compiled from the examinations of 11,709 (5,618 female, 6,091 male) Illinois school children made in thirty-four counties, covering a period from February 1934 to June 1937.

The group of counties in which examinations were made offers a fairly good cross-section of the State of Illinois (Cook County excluded) where the prevailing occupations are farming, dairy farming, mining, industry, etc. (Fig. 1.)

Table 1.—Prevalence of Untreated Dental Caries (Record of 11,709 Children)

Ages	6	7	8	9	10	11	12	13	14	15	16
Children examined	1,066	1,217	1,365	1,270	1,120	1,283	1,152	1,180	895	654	507
Cases of active untreated dental caries	4,791	5,681	6,351	5,750	4,134	2,930	2,394	2,298	2,146	1,850	1,368
Active untreated dental cavities per child	4.4	4.6	4.6	4.5	3.6	2.2	2.0	1.9	2.3	2.8	2.6
Deciduous teeth with active untreated dental caries	4,532	4,869	4,978	4,079	2,436	1,284	539	228	76	27	17
Active untreated dental caries in deciduous teeth (per cent)	92.7	85.7	78.3	70.9	58.9	43.8	22.5	9.9	3.5	1.4	1.2
First permanent molars with active untreated dental caries	259	811	1,357	1,624	1,598	1,441	1,431	1,419	1,123	852	575
Active untreated dental caries in first permanent molars (per cent)	5.4	14.2	21.3	28.2	38.6	49.1	59.7	61.7	52.3	44.9	42.0
Other permanent teeth with active untreated dental caries	0	1	16	47	100	205	424	651	947	971	776
Active untreated dental caries in other permanent teeth (per cent)	0	0.01	0.2	0.8	2.4	6.9	17.7	28.3	44.1	52.4	56.7

*Chief of the Division of Dental Health Education, Illinois State Department of Public Health.

DEFINITION OF DENTAL CARIES

Dorland's "American Illustrated Medical Dictionary" defines dental caries as follows:

Dissolution and disintegration of the enamel and dentin. . . . First degree, dental caries in which the enamel alone has become decalcified. Second degree, dental caries in which the enamel and dentin are affected, the pulp not yet being involved. Third degree, dental caries which has penetrated to the extent of exposing the pulp. Fourth degree, dental caries which has penetrated to the pulp so that the latter has undergone putrefactive decomposition.

METHOD OF EXAMINATION

The examinations of the children reported here have been made by one person. [The author.]

Mouth mirrors, free of blemishes, and good explorers (Nos. 2-7, or similar) were used. The examinations were made in a

TABLE 2.—CHILDREN FREE FROM ACTIVE UNTREATED DENTAL CARIES (RECORD OF 11,709 CHILDREN)

Ages	6	7	8	9	10	11	12	13	14	15	16
Children examined	1,066	1,217	1,365	1,270	1,120	1,283	1,152	1,180	895	654	507
Children free from active untreated dental caries	234	210	229	159	163	268	360	408	286	181	160
Children free from active untreated dental caries (per cent)	21.9	17.2	16.7	12.5	14.5	20.8	31.2	34.5	31.9	27.6	31.5

TABLE 3.—DEGREE OF CARIES (RECORD OF 6,072 CHILDREN)

Ages	6	7	8	9	10	11	12	13	14	15	16
Total examined	515	636	754	642	518	729	640	612	466	331	229
Total cavities	2,232	2,942	3,281	2,848	1,959	1,373	1,365	1,192	1,156	935	576
Degree 1	257	396	448	443	355	271	353	374	369	274	196
Per cent	11.5	13.4	13.6	15.5	18.1	19.7	25.8	31.3	31.9	29.3	34.0
Degree 2	1,761	2,140	2,334	1,916	1,202	888	833	680	688	586	326
Per cent	78.8	72.7	71.1	67.2	61.3	64.6	61.0	57.0	59.5	6.26	56.5
Degree 3	214	406	499	489	402	214	179	138	99	75	54
Per cent	9.5	13.8	15.2	17.1	20.5	15.5	13.1	11.5	8.5	8.0	9.3

TABLE 4.—PREVALENCE OF EXTRACTED TEETH (RECORD OF 3,057 CHILDREN)

Ages	6	7	8	9	10	11	12	13	14	15	16
Children examined	286	304	306	281	284	292	319	338	310	204	133
Extracted teeth	25	47	47	83	66	89	66	81	131	74	48
Deciduous	25	47	44	67	49	43	12	2	0	0	0
First permanent molars	0	0	2	13	17	43	49	66	115	62	34
Other permanent teeth	0	0	1	3	0	3	5	13	16	12	14

TABLE 5.—PERCENTAGE OF DENTAL CARE, HOME CARE AND ORAL HYGIENE BY AGES (RECORD OF 11,709 CHILDREN)

Ages	6	7	8	9	10	11	12	13	14	15	16
Children examined	1,066	1,217	1,365	1,270	1,120	1,283	1,152	1,180	895	654	507
Dental care											
Regular	10.1	17.0	20.8	21.6	19.8	15.8	24.7	23.1	20.0	18.8	18.1
Occasional	27.3	33.5	37.7	39.4	43.1	56.3	49.2	50.0	55.6	56.8	60.9
None	62.4	49.3	41.3	38.8	37.0	27.9	26.9	26.8	24.1	24.3	20.9
Home care											
Regular	35.6	41.4	44.2	38.3	38.2	32.0	44.8	23.5	41.3	50.1	51.2
Occasional	52.3	50.9	50.9	56.2	54.1	63.5	51.6	50.0	54.3	45.1	45.1
None	12.0	7.5	4.0	5.3	7.6	4.3	3.4	26.4	4.3	4.7	3.5
Oral hygiene											
Good	19.0	22.2	23.5	21.2	16.0	15.0	24.8	25.6	21.3	20.7	29.1
Fair	78.2	75.3	73.3	74.7	78.7	82.3	72.0	71.0	74.5	74.4	68.0
Poor	2.7	2.6	3.1	4.0	4.2	2.5	3.1	3.3	4.1	4.7	2.7

Fig. 1.—Counties (in black) in which dental examinations were made.

good light, with the child seated and facing a window.

CLASSIFICATION OF GROUPS

The age groupings of these children were in accordance with the last birthday. Each tooth in the child's mouth was accounted for and recorded during the examination. Missing and extracted teeth were recorded likewise.

EXAMINATION CHART

The dental health examination chart used during these examinations is the new approved one known as the Rhobotham Chart. The use of this chart affords an opportunity to make a dental health examination of each individual child and a dental health appraisal of the school. (Figs. 2-3.)

CLASSIFICATION OF CHILDREN FREE FROM UNTREATED DENTAL CARIES

All children were classed free from active dental caries if there was no untreated caries present in the mouth at the time of the examination. (Table 2.)

DEGREE OF CARIES

The degree of caries in this report was determined in the following manner:

TABLE 6.—PREVALENCE OF ACTIVE UNTREATED DENTAL CARIES (RECORD OF 6,091 MALES AND 5,618 FEMALES)

Ages	6	7	8	9	10	11	12	13	14	15	16
Children examined											
M	529	625	694	650	595	777	598	574	469	327	253
F	537	592	671	620	525	506	554	606	426	327	254
Total cavities											
M	2,527	2,916	3,266	2,901	2,421	1,744	1,275	1,150	1,142	981	723
F	2,264	2,765	3,085	2,849	1,713	1,186	1,119	1,148	1,009	869	645
Cavities per child											
M	4.7	4.6	4.7	4.4	4.0	2.2	2.1	2.0	2.4	3.0	2.8
F	4.2	4.6	4.5	4.5	3.2	2.3	2.0	1.8	2.3	2.6	2.5
Deciduous teeth											
M	2,413	2,532	2,601	2,108	1,501	837	346	151	123	12	6
F	2,119	2,337	2,377	1,971	935	447	193	77	116	15	11
Active caries (per cent)											
M	95.4	86.8	79.7	72.6	61.9	47.9	27.1	13.1	10.7	1.2	.8
F	93.5	84.5	77.0	69.1	54.5	37.6	17.2	6.7	11.4	1.7	1.7
First permanent molars											
M	114	384	654	774	860	802	724	709	709	469	299
F	145	427	703	850	738	639	707	710	421	383	276
Active caries (per cent)											
M	4.5	13.1	20.0	26.6	35.5	45.9	56.7	61.6	62.0	47.8	41.3
F	6.4	15.4	22.7	29.8	43.0	53.8	63.1	61.8	41.7	44.0	42.7
Other permanent teeth											
M	0	0	11	19	60	105	205	290	310	500	418
F	0	1	5	28	40	100	219	361	472	471	358
Active caries (per cent)											
M	0	0	0.3	0.6	2.4	6.0	16.0	25.2	27.1	50.9	57.8
F	0	0.03	0.1	0.9	2.3	8.4	19.5	31.4	46.7	54.2	55.5

TABLE 7.—CHILDREN FREE FROM UNTREATED DENTAL CARIES (RECORD OF 6,091 MALES AND 5,618 FEMALES)

Ages	6	7	8	9	10	11	12	13	14	15	16
Children examined											
M	529	625	694	650	595	777	598	574	469	327	253
F	537	592	671	620	525	506	554	606	426	327	254
Children free from untreated dental caries											
M	114	106	119	84	91	121	188	189	139	89	76
F	120	104	110	75	72	147	172	219	147	92	84
Percentage free											
M	4.5	3.6	3.6	2.8	3.7	6.9	14.7	16.4	12.1	9.0	10.5
F	22.1	17.5	16.3	12.0	13.7	29.0	31.0	36.1	34.5	28.1	33.0

BUREAU of PUBLIC RELATIONS + AMERICAN DENTAL ASSOCIATION + 212 E. SUPERIOR ST., CHICAGO, ILL.

Children's Dental Record Card

NAME (LAST) (FIRST)

CITY OR COUNTY STATE

HISTORY GIVEN BY 1.☐PARENT 2.☐CHILD 3.☐NURSE

☐MALE DATE OF BIRTH

☐FEMALE PLACE OF BIRTH

NATIVITY {FATHER / MOTHER

RACE {☐WHITE ☐YELLOW ☐BLACK / ☐BROWN ☐RED ☐MIXED

SCHOOL {☐PUBLIC ☐PAROCHIAL / ☐PRIVATE ☐INSTITUTIONAL

EXAMINATION BY + PURPOSE OF
1. DENTIST 1. RESEARCH
2. HYGIENIST 2. PRIVATE PRACTICE
3. DENTAL STUDENT 3. HOSPITAL
4. PHYSICIAN 4. SCHOOL CLINIC
5. NURSE 5. DETACHED CLINIC
6. TEACHER 6. SURVEY

DATE OF EXAMINATION										
AGE OF CHILD										
SCHOOL GRADE	KIND.	1	2	3	4	5	6	7	8	
SCHOOL PROGRESS	1. EXCELLENT									
	2. NORMAL									
	3. POOR									
	4. RETARDED									
TEMPERAMENT	1. NORMAL									
	2. NERVOUS									
	3. PHLEGMATIC									
PHYSICAL HISTORY	HEIGHT									
	1. NORMAL WEIGHT									
	2. UNDER WEIGHT									
	3. OVER WEIGHT									
	4. GOOD POSTURE									
	5. POOR POSTURE									
	6. ADENOIDS + IN +									
	7. ADENOIDS + OUT +									
	8. TONSILS + IN									
	9. TONSILS + OUT									
	10. TONSILS + LARGE									
	11. SPEECH NORMAL									
	12. SPEECH DEFECT									
INFANT FEED	BREAST FED NUMBER OF MONTHS									
	BOTTLE FED NUMBER OF MONTHS									
DIETARY HISTORY	1. MILK									
	2. FRUITS									
	3. VEGETABLES									
	4. WHOLE GRAIN									
	5. MEAT + EGGS									
	6. COARSE FOOD									
	7. SUN BATHS									
	8. VITAMIN D									
	9. EXCESS SWEETS									
HOME CARE	1. REGULAR									
	2. OCCASIONAL									
	3. NONE									
DENTAL CARE	1. REGULAR									
	2. OCCASIONAL									
	3. NONE									

DISEASES	AGE
1.☐MEASLES	
2.☐WHOOPING COUGH	
3.☐CHICKENPOX	

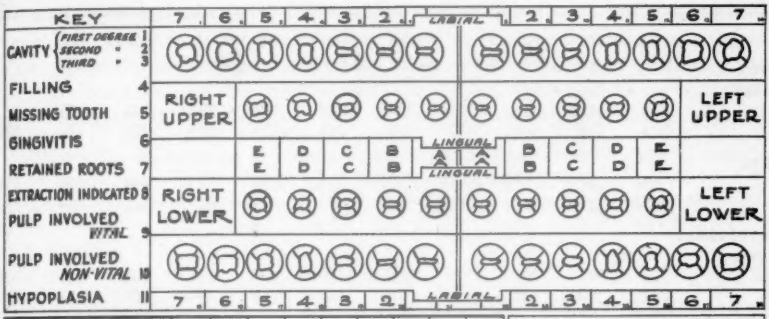
DISEASES	AGE
4.☐SCARLET FEVER	
5.☐DIPHTHERIA	
6.☐TYPHOID FEVER	

DISEASES	AGE
7.☐MUMPS	
8.☐INFANTILE PAR.	
9.☐RICKETS	

SIG. SIG. SIG. SIG. SIG. SIG. SIG. SIG. SIG.

REMARKS:

Figure 2.



		KIND	1	2	3	4	5	6	7	8
DATE OF EXAM.										
AGE OF CHILD										
SCHOOL GRADE										
CAVITIES	DEC.									
	PER.									
FILLINGS	DEC.									
	PER.									
MISSING TEETH	DEC.									
	PER.									
EXTRACTION INDICATED	DEC.									
	PER.									
FIRST PERMANENT MOLAR	UNERUPTED									
	DECAYED									
	EXTRACTED									
	O.K.									
GINGIVITIS	DEC.									
	PER.									
ORAL HYGIENE	GOOD									
	FAIR									
	POOR									
PROPHYL NEEDED										
OCCLUSION	IRREGULAR									
	OVER BITE									
	OPEN BITE									
	CROSS BITE									
	LOWER RETRUSION									
	LOWER PROTRUSION									
	UPPER PROTRUSION									
HABITS	THUMB SUCKING									
	FINGER SUCKING									
	MOUTH BREATHING									
	LIP BITING									
	TONGUE BITING									
	CHEEK BITING									
	RESTING ON HAND									
	SLEEPING ON HAND									
	PACIFIER									

RECORD OF OTHER FINDINGS

TEETH LOCATED BY ROENTGENOGRAMS

SUPERNUMERARY TEETH

REMARKS:

EXAMINED BY:

KIND.
1st
2nd
3rd
4th
5th
6th
7th
8th

TYPE OF EXAMINATION

① GOOD LIGHT. TEETH FREE FROM DEBRIS AND DEPOSITS. DRY TOOTH SURFACES. MAGNIFICATION BY BINOCULAR LUPE. EXPLORER POINTS OF 36 GUAGE OR LESS. INTERPROXIMAL ROENTGENOGRAMS. ② SAME AS TYPE ① EXCEPT FOR ABSENCE OF BINOCULAR LUPE AND ROENTGENOGRAMS ③ GOOD LIGHT. EITHER OR ALL OF THE FOLLOWING: MOUTH MIRRORS; TONGUE DEPRESSORS; EXPLORERS

CHECK TYPE OF EXAMINATION HERE

INSTRUCTIONS: USE DIFFERENT COLORED INK EACH YEAR.
CAVITIES: 1ST DEGREE INVOLVES ENAMEL 2ND DEGREE + DENTIN 3RD DEGREE + PULP
ANY SECTION OF CHART NOT USED SHOULD BE MARKED N.K.
ROOTS ARE CONSIDERED AS TEETH PRESENT
MARK CAVITY OR FILLING BY PLACING KEY NO. ON TOOTH DIAGRAM
MARK OTHER CONDITIONS BY PLACING KEY NO. BELOW TOOTH

Figure 2.

Figure 3.

TABLE 8.—DEGREES OF CARIES (RECORD OF 3,185 MALES AND 2,887 FEMALES)

Ages	6	7	8	9	10	11	12	13	14	15	16
Children examined											
M	256	318	393	325	284	488	317	283	241	158	122
F	259	318	361	317	234	241	323	329	225	173	107
Cavities											
M	1,105	1,445	1,732	1,355	1,210	794	680	575	644	491	364
F	1,127	1,497	1,549	1,493	749	579	685	617	512	444	212
Degree of caries											
Degree 1											
M	125	178	201	223	217	128	175	175	198	141	106
F	132	218	247	220	138	143	178	199	171	133	90
Per cent											
M	11.3	12.3	11.6	16.4	17.9	16.1	25.7	30.4	30.7	28.7	29.1
F	11.7	14.5	15.9	14.7	18.4	24.6	25.9	32.2	33.3	29.9	42.4
Degree 2											
M	863	1,065	1,233	920	737	530	403	343	388	309	220
F	898	1,075	1,101	996	465	358	430	337	300	277	106
Per cent											
M	78.0	73.7	71.1	67.8	60.9	66.7	59.2	59.6	60.2	62.9	60.4
F	79.6	71.8	71.0	66.7	62.0	61.8	62.7	54.6	58.5	62.3	50.0
Degree 3											
M	117	202	298	212	256	136	102	57	58	41	38
F	97	204	201	277	146	78	77	81	41	34	16
Per cent											
M	10.5	13.9	17.2	15.6	21.1	17.1	15.0	9.9	9.0	8.3	10.4
F	8.6	13.6	12.9	18.5	19.4	13.4	11.2	13.0	8.0	7.6	7.5

TABLE 9.—PREVALENCE OF EXTRACTED TEETH BY SEX (RECORD OF 1,561 MALES AND 1,495 FEMALES)

Ages	6	7	8	9	10	11	12	13	14	15	16
Children examined											
M	134	170	170	132	158	149	159	149	170	96	74
F	152	134	136	149	126	143	160	189	139	108	59
Extracted teeth											
M	12	35	31	48	37	59	37	37	70	40	23
F	13	12	16	35	29	30	29	44	61	34	25
Deciduous teeth											
M	12	35	29	36	32	29	11	2	0	0	0
F	13	12	15	31	17	14	1	0	0	0	0
First permanent molars											
M	0	0	1	9	5	27	24	28	59	33	16
F	0	0	1	4	12	16	25	38	56	29	18
Other permanent teeth											
M	0	0	1	3	0	3	2	7	11	7	7
F	0	0	0	0	0	0	3	6	5	5	7

If the explorer caught in a small external aperture of the enamel or if it sank beneath the surface of the enamel, but did not enter the dentin, the cavity was classed as Degree 1. (A majority of this class were defects in the enamel.)

Table 10.—Percentage of Dental Care, Home Care and Oral Hygiene by Ages (Record of 6,091 Males and 5,618 Females)

Ages	6	7	8	9	10	11	12	13	14	15	16
Children examined											
M	529	625	694	650	595	777	598	574	469	327	253
F	537	592	671	620	525	506	554	606	426	327	254
Dental care											
Regular											
M	11.7	15.2	20.0	21.3	16.4	12.3	20.5	19.5	16.6	13.4	15.4
F	8.5	19.0	21.7	21.9	23.6	21.1	29.2	26.5	23.9	24.1	20.8
Occasional											
M	26.6	35.3	39.4	41.5	43.6	61.5	52.0	52.6	56.7	57.4	64.0
F	28.1	31.5	35.9	37.2	42.4	48.0	46.2	47.5	54.6	56.2	57.8
None											
M	61.6	49.4	40.4	37.0	39.8	26.1	27.4	27.8	26.6	29.0	20.5
F	63.3	49.3	42.3	40.8	33.9	30.8	24.5	25.9	21.3	19.5	21.2
Home care											
Regular											
M	33.2	37.6	38.1	30.9	30.7	21.1	30.9	29.7	25.5	30.2	32.4
F	37.9	45.5	50.5	46.1	46.6	48.8	59.9	44.5	58.6	70.0	70.0
Occasional											
M	52.1	52.1	55.4	61.8	59.3	73.2	64.7	62.3	67.3	61.7	60.8
F	52.5	49.6	46.3	50.4	48.1	48.8	37.5	37.1	39.9	28.4	29.5
None											
M	14.5	10.2	6.3	7.2	9.9	5.6	4.3	7.8	7.0	7.9	6.7
F	9.4	4.7	3.1	3.3	5.1	2.3	2.5	18.3	1.4	1.5	0.3
Oral hygiene											
Good											
M	17.7	21.6	21.3	18.7	15.1	8.3	20.7	17.5	13.2	14.0	18.5
F	20.2	22.6	25.7	23.8	19.0	25.2	29.2	33.3	30.2	27.5	39.7
Fair											
M	80.5	75.0	75.3	76.6	78.3	88.0	75.5	78.5	80.3	81.9	77.0
F	75.9	75.5	71.2	72.7	79.2	73.7	68.2	63.8	68.0	66.9	59.0
Poor											
M	1.7	3.3	3.3	4.6	6.5	3.6	3.6	3.8	6.3	3.9	4.3
F	3.7	1.8	2.9	3.3	1.7	0.9	2.5	2.8	1.6	5.5	1.1

If the explorer entered the soft dentin or if the dentin was exposed, the cavity was classed as Degree 2. If the tooth was badly broken down or the pulp exposed, the classification was Degree 3. (Table 3.)

PREVALENCE OF EXTRACTED TEETH

Whenever an extraction had been performed by a dentist, the teeth were considered extracted. (Table 4.) The deciduous teeth had to be removed prematurely, owing to caries or an accident, before they were considered as extracted teeth. All extracted permanent teeth were so considered.

PREVALENCE OF DENTAL CARE

Children who had visited their dentists

for corrections once a year for the past four or five years were considered as having "regular dental care."

Children who visited their dentists only occasionally were considered as having "occasional dental care." (A majority of these children had been to a dentist only once during their entire lives, and then to have a tooth extracted.)

Children who had had no dental care by a dentist were considered as having "no dental care." (Table 5.)

PREVALENCE OF HOME CARE

Children who brushed their teeth at least once every day were considered as having "regular home care." However, a condition of regular night and morning brushing was preferred.

Children who brushed their teeth only once in a while were considered as having "occasional home care."

Children who never brushed their teeth were considered as having "no home care." (Table 5.)

PREVALENCE OF ORAL HYGIENE

Children whose teeth were absolutely free from all stains and deposits, and whose gums were in a healthy condition were considered as having "good oral hygiene."

Children whose teeth had a stain, however slight, were considered as having "fair oral hygiene."

Children who had bad mouth conditions, serious stains and deposits were conconsidered as having "poor oral hygiene." (Table 5.)

DENTAL HEALTH IN PEORIA, ILLINOIS

ADVOCATES of children's dentistry will be pleased to learn that the Peoria, Illinois school dental program was considerably enlarged and improved last Fall. The work of C. Carroll Smith, pioneer dental educator, backed by the Peoria Dental Society, has, after twenty years, received the reward it so justly deserves.

Twenty years ago, when he first assumed the duties of school dentist, Dr. Smith realized that to achieve lasting results more was needed than operative service for children of families unable to pay. He advocated then, as he does now, a definite educational program for all children. He recommended annual dental examinations and the use of educational material graded for the different age levels and arranged so that it will fit into the regular school curriculum. So successful has been the establishment of Dr. Smith's principles that his practical teaching material is enthusiastically received by both pupils and teachers. His methods are copied by educators in other cities and in other lands.

At the opening of the 1937 fall term of school, the Peoria Board of Education added two dentists and two dental assistants to their one-man dental staff. Therefore, Dr. Smith has, besides his secretary, one full-time and one half-time dental assistant. The new members of the staff operate Peoria's three school dispensaries.

Two of these dispensaries were established by the school board several years ago. One was recently established by the Peoria Junior League and the Peoria Dental Society.

The Junior League members maintain an active interest in the school dental health work. An arrangement has been made with them whereby all difficult extraction cases and those requiring general anesthesia are sent to the officers of the private exodontists in the city.

This enlarged program permits Dr. Smith to devote all of his time, except for supervising the clinics, to dental educational work, which he greatly enjoys and is especially fitted for.

NATIONAL DENTAL HEALTH POSTER CONTEST

E. HARVEY RICHMOND, chairman of the poster committee of the Connecticut State Dental Association in the National Dental Health Poster Contest, reports that the Connecticut Association is offering something different in the way of awards to the winners of their state poster contest. The first award is two weeks' outing at Camp Rainbow, Conn.; second award, one week's outing at Camp Rainbow, Conn.; third award, two tickets to the circus plus spending money. High school and vocational school children may choose between the camp outing and a chaperoned trip to New York City.

One hundred sixteen county chairmen serving eighty-six counties are promoting the Tennessee State Poster Contest under the direction of Walter T. McFall. Over 2,500 pieces of literature have been mailed to the schools. The state contest ends April 15. Five first prizes of $25 each; five second prizes of $12.50 each, and five third prizes of $10 each will be awarded the winners at the annual state dental meeting held in Chattanooga in May.

George C. Brown, chairman of the poster committee in Massachusetts, reports that the state and district dental societies are offering substantial cash prizes to the poster contest winners. One component society is offering a grand prize of $35. The state society will probably offer a grand prize of $50.

The Arkansas State Dental Society is going over the top in the poster contest. M. H. Gray, chairman, advises that the Little Rock contest is well under way and that the other districts in the state are well organized. Cash prizes totaling $120 are being given as awards.

DENTAL CARIES IN CHILDREN

ONE hundred well children susceptible to caries were compared with an equal number relatively immune, in terms of constitutional, endocrine, metabolic, nutritional and oral factors.

Seven per cent of the children studied had a familial susceptibility to caries, whereas 9 per cent had an individual immunity. The caries-susceptible children showed teeth with steep cusp-inclines and food-impacting areas paralleling the tooth structures inherited from one of the parents. Susceptibility or immunity to caries of some children may be explained on the basis of Mendelian segregation.

Ten per cent of the children with chronic caries had hypothyroidism, hyperthyroidism, hypopituitarism and hyperparathyroidism in contrast with 8 per cent immune in cases of adiposogenitopituitarism, hyperpituitarism and hyperthyroidism. Tooth decay was not arrested until the endocrine disturbances were corrected.

Twelve per cent of the children with caries had metabolic disorders—cyclic vomiting, celiac disease, alimentary allergy, epilepsy and chronic sinusitis, in contrast with 8 per cent immune in cases of diabetes and hemophilia. Tooth decay was not arrested until the metabolic conditions were alleviated, for that which is absorbed and utilized rather than that which is offered is significant in resistance to decay.

Sixty-four per cent of the children with caries were on a suboptimal diet in contrast with 66 per cent who were resistant to caries on the basis of satisfactory nutritional intake. The dietary deviations in carbohydrate, acid-base ash, calcium and vitamins A, C and D were corrected and caries was arrested within three months in 65 per cent of the children.

Seven per cent of the caries-susceptible children showed local factors causing decay, whereas 9 per cent of those resistant to caries practiced excellent mouth care, systemic factors being borderline with respect to caries.—Newton Kugelmass, M.D., *New York State J. Med.*, October 15, 1937, p. 1733-1742; abstr. *J. School Health*, January 1938.

DENTAL CONDITIONS

A RECENT dental survey of 46,000 school children in San Francisco reveals many startling facts, among them the following: At present in San Francisco before the 10-year-group is reached, a large percentage of children have had no dental care. Even after the 10-year-age group is passed, less than 60 per cent of the children have had dental care. Approximately 80 per cent of the 10-to-12-year-old children have dental defects. Nearly one-third of the first permanent molars are carious.

The findings of this survey, a WPA project, suggest the need for such a survey in other cities and for a more adequate dental program throughout the nation.—*J. Nat. Ed. A.*, December 1937, p. 312; abstr. *J. School Health*, January 1938.

RURAL DENTAL HYGIENE

A PUBLIC health service that is much needed in rural areas throughout the state and that has been stamped with the whole-hearted approval of school authorities and teachers as well as parents is being demonstrated in Oneida county.

In connection with its state aid nursing service, the county has employed a whole-time dental hygienist to supplement the work done by the county dentist in rural schools. The hygienist examines and cleans the teeth of the children, notes those in need of dental service, and makes appointments through the public health nurses for treatment by the dentist of those children whose parents are unable to pay for the services of a private dentist. Lay committees and interested agencies arrange for transportation of these children to the county dental clinic at Broadacres. The work is educational as well as practical. While the children's teeth are being cleaned, the value of oral hygiene is demonstrated, and the importance of proper diet as an essential of dental health is explained.

The need for full-time service of this kind is evident from the report of the dental hygienist for October 18-November 5. During this period, a total of twenty-one district schools were visited or represented, 183 prophylactic treatments were given and 141 children were found to need dental attention, including eighty-three urgent cases.

District superintendents of schools in the county are unanimous in their approval of this service. Teachers are delighted with the expansion of the school health program, parents are showing their interest by having defects corrected as soon as possible, and children are taking pride in keeping their teeth clean. As a result of the favorable reception given this work, the Oneida County Board of Supervisors has included in the budget for 1937-1938 an appropriation for a full-time dental hygienist.—*Heath News, State Dept. of Health, New York*, November 29, 1937, p. 195; abstr. *J. School Health*, January 1938.

DENTAL CONFERENCES

The dental staff of the Bureau of Child Hygiene of the California State Board of Public Health is now composed of three dentists and a dental hygienist. They have worked in eleven counties, holding forty-one conferences, have instructed 1,868 children on the care of the teeth and have examined the teeth of 357 children. In addition, 565 dental operations have been performed on seventy-one children. These activities during the month of October were carried on in Trinity, Modoc, Lassen, Alpine and Mono counties.

During the month, dental unit number one, a fully equipped trailer, was exhibited before the Twelfth District Dental Society at Alturas.—*California & West. Med.*, January 1938.

DENTAL ECONOMICS

REPORT OF A SURVEY OF 25,222 DENTISTS SHOWING THE PERCENTAGE EMPLOYING ASSISTANTS, HYGIENISTS AND TECHNICIANS

THE following tables are compiled from the answers to a questionnaire sent out by the Economics Committee of the American Dental Association to approximately 100 of the largest cities in the country. The replies received from about sixty-six cities are included.

From several cities, more than one reply was received, and the discrepancy between these replies casts some doubt on the accuracy of those from other cities. However, consideration of all the replies as a group may afford some fairly reliable estimates as to the number of dentists who employ the various types of assistants.

TABLE 1.—DATA FROM LARGER CITIES

City	Practicing in City and Suburban Areas	Employing Assistants Per Cent	Employing Hygienists Per Cent	Employing Technicians Per Cent	Employing Two Persons*	Employing Three Persons†
Akron, Ohio	212	44	1	7	7	1
Albany, N. Y.	125	75	10	2	2	0
Atlanta, Ga.	300	80	16	2	10	0.3
Baltimore, Md.	875	30	0	2	30	0
Bethlehem, Pa.	159	44.6	3.1	1.2	3.1	0.6
Boston, Mass.	1,061	50	15	5	7	1
Camden, N. J.	108 (county)	43	0	0	0	0
Chattanooga, Tenn.	71	90	1.43	4.29	4.29	1.43
Chicago, Ill.	4,700	40	0	0.2	No data	No data
Cleveland, Ohio	1,100	60	1	1.5	1	0
Columbus, Ohio	265 (dental society)	18.8	1.8	1.8	0	0
Dayton, Ohio	157	75	2	4	0.66	0.66
Dallas, Texas	204	75	0	2	2	1
Denver, Colo.	475	60	2	1	0.5	0.5
Des Moines, Iowa	160	76	1	0	0	0
Detroit, Mich.	1,300	55	7	2.5	1.5	0.4
Dubuque, Iowa	55	50	0	0	0	0
Duluth, Minn.	104	40	2	0	0	0
El Paso, Texas	58	75	0	8	8	0
Evansville, Ind.	60	75	0	2	0	0
Flint, Mich.	95	75	5	10	10	5

*Two types of workers of a possible three. †Assistant, hygienist and technician.

(Continued on next page)

TABLE 1.—DATA FROM LARGER CITIES (CONTINUED)

City	Practicing in City and Suburban Areas	Employing Assistants Per Cent	Employing Hygienists Per Cent	Employing Technicians Per Cent	Employing Two Persons*	Employing Three Persons†
Fort Wayne, Ind.	78	30	0	0	0	0
Fort Worth, Texas	100	100	0	1	1	0
Fort Worth, Texas (different source)	97	65	0	5	5	0
Fresno, Calif.	55 (city)	80 (city)	0 (city)			
	150 (suburban)	50 (suburban)	1 (suburban)	3 (suburban)	3 (suburban)	0
Houston, Texas	244	70	0	5	0	0
Indianapolis, Ind.	420	20	0	1	1	0
Jacksonville, Fla.	72	98	10	4.5	4.5	4.5
Jersey City, N. J.	175 (city)					
	350 Hudson Co.	25	0	2	2	0
Kansas City, Kan.	67	5	2	0	1	0
Knoxville, Tenn.	71	54	3	2	2	0
Louisville, Ky.	172	60	0	2	?	0
Memphis, Tenn.	175	90	5	5	3	2
Milwaukee, Wis.	824	4	6	2	1	0
Minneapolis, Minn.	600	35	24	78	8	1
Nashville, Tenn.	110	68	6	3	9	1
New Bedford, Mass.	100	35	5–10	1–2	1–2	1–2
New Orleans, La.	347	65	0.2	2	2	0
Newark, N. J.	460	82 (est.)	0	82 (est.)	68 (est.)	0
Norfolk, Va.	82	45	0	1	0	0
Oakland, Calif.	500	75	10	5	10	?
Omaha, Nebr.	200	70	0	1	1	0
Omaha, Nebr. (different source)	225	40	0	2	2	0
Paterson, N. J.	213	55	3 (can work as assistants only)	2.5	2.5	0
Peoria, Ill.	95	60	0	1	2	0
Pittsburgh, Pa. (9 counties)	1,670	44 (of 363 who answered questionnaire)	0.4	0.3	0.3	0
Providence, R. I.	422	15	15	2	0	0
Reading, Pa.	101	30	3	0	0	0
Richmond, Va.	129	50	0	2	0	0
Rochester, N. Y.	472	No data	25	No data	No data	No data
Sacramento, Calif.	180	75	0	10	0	0
St. Louis, Mo.	1,035	20	0	4	4	0
St. Louis, Mo. (different source)	975	14	0	1.5	1.5	0
St. Paul, Minn.	375	35	15	1	2	0.5
San Antonio, Texas	135	80	0.7	4	0	0
San Francisco, Calif.	2,460 (18 surrounding counties)	40	1	1	1	0
Schenectady, N. Y.	65	70	15	1.5	0	0

(Continued on next page)

TABLE 1.—DATA FROM LARGER CITIES (CONTINUED)

City	Practicing in City and Suburban Areas	Employing Assistants Per Cent	Employing Hygienists Per Cent	Employing Technicians Per Cent	Employing Two Persons*	Employing Three Persons†
Scranton, Pa.	215	60	4	4	1	1
Seattle, Wash.	500	60	5	5	3	1
South Bend, Ind.	90	90	0	0	0	0
Spokane, Wash.	118	40	1	?	?	?
Syracuse, N. Y.	125	80	10	4	7	1
Tacoma, Wash.	100	50	2	1	0	0
Tampa, Fla.	56	75	1	0	0	0
Toledo, Ohio	220	25	2	5	4	4
Tulsa, Okla.	102	50	1	3 (advertisers)	3 (advertisers)	0
Washington, D. C.	705	95	5	20	0	5
Wichita, Kan.	85	20	5	0	25	25
Wilmington, Del.	78	85	2	0	0	0

TABLE 2.—DATA FROM NORTH CAROLINA*

City	Practicing in City and Suburbs	Employing Assistants Per Cent	Employing Technicians Per Cent	Employing Assistant and Technician Per Cent
Winston-Salem	35	100	0	0
Charlotte	59	96	1+	1+
Durham	19	75	0	0
Raleigh	40	75	0	0
Greensboro	35	60	0	0
Wilmington	21	72	0	0
Rocky-Mount	13	60	0	0
Asheville	40	90	5	5
Total	262	83 (218 assistants)	0.009 (3 technicians)	0.009 (3 employed)

*Not included in Table 1 because these replies are from small cities and they offer an interesting comparison between the larger and smaller communities. Apparently, a larger percentage of dentists in the smaller cities employ assistants, but a smaller percentage employ technicians. Hygienists are not licensed to practice in private offices in North Carolina (1929 statute).

TABLE 3.—RESULTS OF TWO GENERAL SURVEYS*

Survey	No. of Dentists	Assistants		Hygienists		Technicians		Two of Three Types of Workers		Three Possible Types of Workers	
		No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Ritter Dental Mfg. Co.*	15,866	6,682	42.11	579	3.64	389	2.45	313	1.97	85	0.53
A. D. A.	25,222	11,383	46	1115	4.4	651	2.5	855	3.3	116	0.60

*These figures have been placed in a separate table because they make no differentiation between cities. Although obtained from a different source, they compare very favorably with those compiled by the Economics Committee of the American Dental Association. This similarity should add weight to the validity of both.

SCHOOL DENTAL NURSES IN NEW ZEALAND

NEW ZEALAND, which is roughly the same size as Great Britain, is essentially a farming country. Approximately half of its 1,587,000 population live in its four large cities. The remainder live in the widely scattered villages or on farms. There are about 250,000 primary school children, 97 per cent of whom are affected by dental disease.

Confronted with the problem of supplying preventive dental care for these children, the Dental Division of the New Zealand Department of Health developed a program based upon complete service to the number of children that they could cover with their limited staff. School dental nurses who have had two years training in operative dentistry are employed for this purpose. New Zealand's first dental nurses commenced their two years training in 1921. Since then, the service has grown until today the staff of dental nurses are caring for the dental needs of about 90,000 children in 1,600 schools.

SELECTION AND TRAINING OF DENTAL NURSES

Candidates must be between 19 and 25 years of age; must pass an entrance examination; must be over 5 feet and 3 inches in height, and must have a good physique and personality and good dentition. Wearers of artificial dentures are disqualified. Candidates who have passed the entrance examination enter the department's training school at Wellington. Before receiving training, they sign a contract agreeing to remain in the service for five years after graduation.

TRAINING

The first year's training consists of courses in anatomy, physiology, histology, pathology, etc. A short course in metal work to develop manual dexterity is also included. During the last four months, the students are given daily instruction in preliminary operative work. The second year's training is devoted almost entirely to the actual treatment of children. The operative work is limited to prophylaxis, fillings and extractions under local anesthesia for children up to the age of 12. Dental health education and public speaking are included in the second year's course. Nurses are encouraged to develop original health educational material.

FIELD WORK

The dental nurses cannot engage in any form of private practice. Their activities are limited entirely to school work. On graduation, each nurse is assigned to a school or school district. Each nurse is expected to keep 500 patients dentally fit. She must see each child every six months. She provides this service to children between the ages of 5 and 12. Parents are encouraged to bring preschool children to the school clinics for care. Copper amalgam is used in the deciduous teeth, silver amalgam in the permanent teeth. Prophylactic odontotomy is performed on the first permanent molars. The dental nurses are supervised by the dental officers of the department of health. Communities desiring government dental nursing service for their children appoint a dental clinic committee. This committee undertakes certain financial obligations on behalf of the parents whom it represents. It provides the clinic, built to the department's plans, provides the necessary nontechnical furnishings, defrays certain local expenses and pays the department 30 pounds per annum to cover the cost of materials. The committee may levy a charge of not more than 5 shillings a year for each child treated. These charges may be remitted or modified if the committee so chooses. At present, New Zealand operates 252 school dental clinics, 144 of

which are main treatment centers and 188 of which are substations. Reports indicate that the government is contemplating building a larger training school for dental nurses and considerably increasing their field staff.*

*Digested from article by I. L. Saunders in *J. Canad. D. J.*, November 1937.

FEDERAL INCOME TAX DEDUCTIONS

THE following general information is offered in order to aid dentists in making out their income tax forms. Those in doubt regarding any specific item should call the local bureau of internal revenue. The following items are deductible:

Professional expenses:

Cost of supplies and materials used in practice.

Expense of making outside professional calls.

Dues to professional societies.

Subscriptions to professional publications.

Malpractice and office insurance premiums.

Office rent, heat, light, water, repairs, etc.

Office stationery, postage, telephone, etc.

Salaries of office employes.

Current expenditures for professional books, instruments, equipment and office furniture the useful life of which is short.

Depreciation on office furniture and equipment of more permanent nature.

Cost of outside services pertaining to practice such as laboratory work and accounting and legal fees.

All interest is deductible except interest incurred on money borrowed to purchase or carry obligations or securities, the interest on which is wholly exempt from federal income tax, and on indebtedness incurred to purchase or carry annuities.

Generally, all taxes are deductible except federal income and excess profit taxes and special assessments levied which tend toward the improvement of property owned.

Losses incurred on transactions entered into for profit and from bad debts are subject to definite limitations, which should be ascertained when such losses occur.

Contributions or gifts to non-profit organizations or institutions for charitable or public purposes are deductible up to 15 per cent of the net income of the taxpayer.

COUNCIL ON DENTAL THERAPEUTICS

ACCEPTED DENTAL REMEDIES

The following articles have been accepted as conforming to the rules of the Council on Dental Therapeutics of the American Dental Association. The Council wishes dentists to understand that the admission of an article does not imply a recommendation. A copy of the rules that govern the Council in the consideration of articles will be sent on request.

COUNCIL ON DENTAL THERAPEUTICS.

DENTIFRICES*

Rojane Dental Cream: Composition: See Sheffield Tooth Paste (A.D.R. 1937, p. 110).

Manufactured by the Sheffield Company, New London, Conn. Distributed by Miller & Paine, Lincoln, Nebr. No U. S. patent or trademark.

Burkes Dental Cream: Composition: Each 100 gm. is stated to contain gum tragacanth, 0.69 gm.; alcohol (38B), 0.69 gm.; glycerin, 20.17 gm.; water, 30.75 gm.; light precipitated calcium carbonate (Snow Top), 40.65 gm.; magnesium hydroxide, 5.25 gm.; soap, 0.60 gm.; flavoring solution (alcohol, oil of spearmint, oil of cassia, oil of sassafras, oil of wintergreen, oil of star anise, oil of cloves, oil of orris, oil of lemon, menthol, recrystallized), 1.04 gm.; saccharin, 0.14 gm.

Abrasiveness: 5.19 mg. on antimony block under a weight of 100 gm. per 5,000 revolutions (Victor apparatus [A.D.R. 1937, p. 91]).

Manufactured by Lactona, Incorporated, Saint Paul, Minn.

ANESTHETICS—LOCAL†

Procaine Solution 2% with Epinephrine 1:25,000-Premier Brand: Each cubic centimeter is stated to contain procaine hydrochloride, 0.02 gm.; epinephrine hydrochloride, 0.00004 gm.; disodium phosphate, 0.003 gm.; sodium chloride, 0.0026 gm.; sodium bisulfite, 0.0015 gm., and distilled water.

Manufactured by K. Reisman, Philadelphia, Pa. Distributed by Premier Dental Products, Philadelphia, Pa. No U. S. patent or trademark.

Procaine Solution 2% with Epinephrine 1:25,000-Premier Brand in Tubes, approximately 2.5 cc.

Procaine Solution 2% with Epinephrine 1:50,000-Premier Brand: Each cubic centimeter is stated to contain procaine hydrochloride, 0.02 gm.; epinephrine hydrochloride, 0.00002 gm.; disodium phosphate, 0.003 gm.; sodium chloride, 0.0026 gm.; sodium bisulfite, 0.0015 gm., and distilled water.

Manufactured by K. Reisman, Philadelphia, Pa. Distributed by Premier Dental Products, Philadelphia, Pa. No U. S. patent or trademark.

Procaine Solution 2% with Epinephrine 1:50,000-Premier Brand in Tubes, approximately 2.5 cc.

Procaine Solution 2% with Neo-Synephrine Hydrochloride 1:10,000-Premier Brand: Each cubic centimeter is stated to contain procaine hydrochloride, 0.02 gm.; neosynephrine hydrochloride, 0.0001 gm.; disodium phosphate, 0.003 gm.; sodium chloride, 0.0026 gm.; sodium bisulfite, 0.0015 gm., and distilled water.

Manufactured by K. Reisman, Philadelphia, Pa. Distributed by Premier Dental Products, Philadelphia, Pa. No U. S. patent or trademark.

Procaine Solution 2% with Neo-Synephrine Hydrochloride 1:10,000-Premier Brand in Tubes, approximately 2.5 cc.

*A.D.R. 1937, p. 105.
†A.D.R. 1937, p. 36.

The Council requested the firm to submit evidence that the epinephrine and neosynephrine content of the finished products were of the stated content according to the acceptable methods of assay. The description submitted by the firm of the method used for controlling the epinephrine content was familiar and satisfactory. However, the chemical test proposed for controlling the neosynephrine content had not been previously used for this compound. The firm stated that neosynephrine contained a monohydroxybenzene nucleus and reacted like any phenol with Millon's reagent, which was used in the test. Snell (Colorimetric Analysis, 1937, p. 365) gives a detailed description of the reaction and some of its applications in his book.

PRACTICE IN PARAGRAPHS

This department is intended for busy readers. It aims to tell a vivid story in a few words. Items should be of a practical character, and free from padding—not more than a paragraph or two. We exact no limit, but two hundred words can tell most of these stories. Send in your ideas; they will be welcome.

Dull Burs as Polishers—Dull burs should not be discarded as they make good polishers for brightening up discolored amalgam fillings. The round burs are particularly useful for smoothing off and polishing small amalgam fillings and in reaching into carved grooves and pits.—*Sidney P. Stone, Dorchester, Mass.*

Cavity Preparation—When it is necessary to insert an inlay in a cavity in which the gingival border lies at the attachment of the cervical fibers, the dryness of the cavity must be assured when the filling is seated. The presence of saliva or blood in the cavity at that time means a recurrence of decay. The rubber dam is applied and held down on the buccal and lingual aspects with a cervical clamp to stretch it across the interproximal area. The cavity is cleaned and sterilized with tincture of metaphen or silver nitrate solution and eugenol. A matrix is then adjusted and warm compound applied to hold it solid, and the gingival portion is filled with well-condensed amalgam before the rubber is removed. In ten minutes, the amalgam should be hard enough to permit final shaping so that the operator can proceed with wax pattern or impression without folding soft tissue under the band. There will be no seepage after the cavity is dried and ready for cementing the inlay, since the margin is now above the danger zone.—*C. H. Blanchard, Los Angeles, Calif.*

Cavity Linings—Much trouble can be averted by lining a gingival cavity regardless of depth. If the cavity is shallow, phenol plus a cavity lining will suffice; if fairly deep, a cement lining in almost all cases will prevent sensitiveness following insertion of the filling. Carbo-eugenol may also be used as a lining, but should be applied at two sittings.—*Samuel Friedman, Baltimore, Md.*

INCIDENTS OF PRACTICE

Elimination of Large Radiolucent Periapical Area Without Resort to Apicoectomy

By Leon Lieber, D.M.D., New York City.

History.—A man, aged 44, married, of Italian birth, of strong, healthy constitution and who did not indulge in smoking or drinking, complained of discomfort and slight swelling in the area of the lower left central incisor.

Examination.—A full series of roentgenograms revealed an excellent set of teeth with a few small fillings. The lower central incisors showed a large radiolucent periapical area, extending from the right to the left lateral incisors and apparently involving both central incisors. (Fig. 1.) The left central incisor was slightly discolored. There were no carious areas and no fillings in any of the lower anterior teeth. The patient recalled having inadvertently bitten on a tack twelve years previously, a momentary shock to the tooth resulting. There was no other history of mouth discomfort.

Treatment.—March 20, 1934, the left lateral incisor was opened and a profuse discharge of pus followed. A formocresol dressing was applied and a temporary cement filling inserted. The canal was subsequently enlarged, with profuse pus discharge, at each visit.

April 19, 1937, under infiltration anesthesia, the labial tissues were incised and an iodoform drain was inserted. A solution made with chloramine tablets was then forced down the canal and out of the opening in the soft tissues with a Luer syringe. From 3 to 5 ounces of solution was forced through at each visit, every other day, until April 27, when the canal proved to be dry and was immediately filled with chlororesin and gutta-percha. (Fig. 2.) It was slightly overfilled, with the expectation that an apicoectomy would be performed in the immediate future. The patient felt very well and it was decided to keep the area under observation. Roentgenograms, made May 7, as was to be expected revealed no bone improvement, but there was no longer any soft tissue involvement. Roentgenogram taken a year later (Fig. 3) revealed almost complete bone regeneration. The patient stated that the slight pains he had suffered in his knees during previous winters had disappeared. On his recall more than three years later, a roentgenogram (Fig. 4) demonstrated excellent healing and there was no discomfort of any kind.

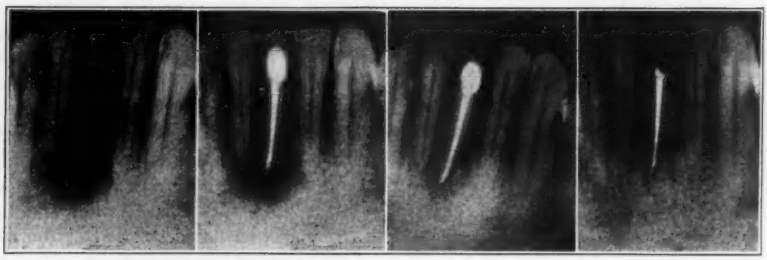


Fig. 1. Fig. 2. Fig. 3. Fig. 4.

385 Fort Washington Avenue.

Root Erosion

By H. Martin Berman, D.D.S., Floral Park, N. Y.

Mrs. M. M., aged 39, had been wearing a cantilever bridge on the upper right central incisor, to which was attached a lateral incisor pontic. The pontic was of the Steele type, but the porcelain facing had been broken

off. The abutment used was an open-face shell crown, placed, of course, on the right central incisor. The bridge had been worn for fifteen years.

Since the patient was desirous of having the upper jaw restored, a full series of roentgenograms were taken to aid in the diagnosis. The upper right central incisor showed a circular area of radiolucency about one-third of the way up on the root surface. On careful examination, the tooth was found to be hopelessly mobile and pulpless as well. The portion of the root which showed radiolucency was not visible clinically.

Shortly thereafter, the tooth was extracted and examined. The labial and distolabial portion of the lower third of the root was completely eroded down to the level of the root canal. There was no evidence of caries. The dentin and cementum were clean looking and showed no softening whatsoever. The opening into the root canal was so large that

a silver abscess probe could be passed into the canal and either up or down within the canal. The shape of the eroded area was such as would result if a large round bur were placed on the root surface and allowed to bur its way into the root canal.

In my opinion, this unusual condition is the result of a definitely traumatic occlusion. The occlusion of the upper right central incisor was such that when the patient closed in centric position, the labial face of the lower incisor struck the lingual aspect of the upper incisor so hard that the upper incisor was displaced labially. Incidentally, the patient remarked that her dentist had repeatedly replaced the porcelain on the upper lateral incisor pontic, only to have it fracture again in a short time.

2 Whitney Avenue.

Fracture of a Cuspid Tooth

By Edmund M. Glavin, D.D.S., Chicago, Ill.

A woman, aged 32, with an extremely swollen upper lip and suffering severe pain, gave a history of injury from a blow twenty-four hours previously. The cuspid root was intact, but no information was available as to the whereabouts of the crown of the tooth. A roentgenogram revealed the fractured

crown apparently floating in space. The crown was removed from the inner surface of lip, with immediate relief of the pain. Formation of scar tissue, with loss of sensation and muscle tone in that particular area of the lip, followed.

1535 West Seventy-Ninth Street.

Case of Fourth Molar

By Glen Patton, D.D.S., Bakersfield, Calif.

The accompanying roentgenogram reveals impacted third and fourth molars

lying in a position horizontal to the adjacent teeth. Rarely do we find a fourth molar, and when we do, it is usually in a vertical position, but to find the third molar lying beneath the fourth molar is extremely unusual and, I may say, was quite a surprise to the unsuspecting dentist.

407 Hopkins Building.

CURRENT LITERATURE

Demonstration of Type Specific Proteins in Extracts of Fusobacteria

By C. Weiss and D. Mercado

Four strains of "fusobacteria" isolated from cases of pyorrhea and lung abscess were studied to determine whether it was possible to justify the classification of these bacteria into types. With the method of Heidelberger and Kendall, immunologically type specific proteins were extracted from mass cultures of three types of fusiform bacteria. The authors believe that this represents an instance of the bacterial protein functioning as a determinant of bacterial types. The authors' data also indicate that there is present a group specific carbohydrate among these bacteria. This work is interesting because it strengthens the opinion that fusiform bacteria should be divided into at least three types.—*J. Exper. Med.*, 67:49, 1938.

M. K. Hine.

Vitamin Requirements and Presence in Foods

In the present state of scientific knowledge, only tentative estimates of daily vitamin requirements can be made. However, there is good evidence for the belief that prolonged daily intake of less than 2,000 international units of vitamin A, 200 international units of vitamin B and 300 international units of vitamin C will lead to the development of definite deficiency disease. The consensus is that an optimal intake for supporting growth, promoting nutrition and providing for maximum storage is approximately 4,000 to 6,000 international units of vitamin A, 300 to 400 international units of vitamin B, 600 to 1,200 international units of vitamin C and 600 Sherman-Bourquin units of vitamin G (riboflavin). No definite requirements for vitamin D for adults can be stated. For infants, the Council on Foods is of the opinion that at least 135 international units of vitamin D is required to prevent rickets and 400 international units is required for best growth. There are available a variety of commercial preparations which supply vitamin A in concentrated form. The Council on Pharmacy and Chemistry has accepted a number of brands of cod liver oil concentrate dispensed either in liquid (bottled or in capsules) or in tablet form, as well as a solution of pure carotene in cottonseed oil. The cod liver oil concentrate capsules supply approximately 10,000 international units of vitamin A and 1,400 units of vitamin D per capsule. The cod liver oil concentrate tablets supply approximately 3,000 U. S. P. units of vitamin A and 300 international units of vitamin D per tablet, whereas the solution of carotene in oil provides not less than 7,500 units of vitamin A per gram, with no vitamin D. The Council has also accepted several brands of halibut liver oil marketed either in liquid form or in capsules which provide approximately 10,000 units of vitamin A and 170 international units of vitamin D per capsule. Information concerning the various accepted brands may be found in N. N. R. for 1937. Concentrated sources of vitamin B are dried brewers' yeast and wheat germ, a number of brands of which have been accepted by the Council on Foods (*J.A.M.A.*, September 12, 1931, p. 780; Aug. 1, 1931, p. 321; Jan. 2, 1937, p. 47; June 30, 1934, p. 2187; Oct. 2, 1937, p. 1127). Quantitative data regarding the vitamin content of a large number of common foods may be found in the recently published U. S. Department of Agriculture Miscellaneous Publication 275, entitled "The Vitamin Content of Foods" by Ester Peterson Daniel and Hazel P. Munsell. A second printing of this pamphlet has been made and is now available for distribution. Another source of quantitative data concerning the mineral and vitamin content of foods is "The Laboratory Handbook for Dietetics" by Mary S. Rose, fourth edition, New York: Macmillan Company.—Queries and Minor Notes, *J.A.M.A.*, 110:227, January 15, 1938.

M. K. Hine.

Leading Causes of Death

To the Editor: What are the ten most important causes of death in the United States?

Answer: The mortality in 1933, according to Britten (*Pub. Health Rep.*, 51:1, July 17, 1936), as based on the crude annual death rate per hundred thousand is as follows:

Diseases of the heart	228.0
Cancer and other malignant tumors	102.2
Influenza and pneumonia	95.6
Nephritis and other kidney diseases	85.7
Cerebral hemorrhage	84.0
Tuberculosis	59.5
Diseases of early infancy	50.6
Automobile accidents	24.7
Diabetes mellitus	21.3
Diarrhea and enteritis	17.2

For the industrial policy holders of the Metropolitan Life Insurance Company for the year 1934 (Armstrong: Competitive Plagues of Mankind, *Better Health*, August, 1935), the seven leading causes of death per hundred thousand were listed as:

Heart disease	162.7
Cancer	96.0
Pneumonia	65.0
Chronic nephritis	64.8
Cerebral hemorrhage	63.2
Tuberculosis	59.3
Accidents (all forms)	57.8

For further details on this subject the annual compilations of the Bureau of the Census, called "Mortality Statistics," should be consulted.—Queries and Minor Notes, *J.A.M.A.*, 110:149, January 8, 1938.

M. K. Hine.

Root Resorption Following Orthodontic Treatment

To the Editor: A man, aged 24, well proportioned, weighing 165 pounds, and 5 feet 10 inches in height, has been informed that he will lose his teeth in a few years. He has had orthodontic treatment for a period of four years under the care of an eminent and capable orthodontist. X-ray examination of the teeth prior to treatment revealed normal roots and an excellent condition of all his teeth. Traumatic occlusion was present previously and is present now. Cosmetically, however, the result is good. The general physical and mental status of the young man is excellent. He eats a well-balanced diet of fresh foods, vitamins and minerals. X-ray examination of his teeth after orthodontic treatment reveals absorption of the roots, a condition which was not present four years ago when it was instituted. On this basis, an eminent pharmacologist and physician prophesied that he would lose his teeth in a few years. Apparently, the traumatic occlusion, which is still present, indicates a bad prognosis. Your opinion is desired as to etiology and treatment.

Answer: A reasonably satisfactory answer to this question could be made only after an examination of the patient and a careful study of accurate casts of the mouth and roentgenograms. In their absence, however, some general statements can be made. First, traumatic occlusion is an indefinite and controversial concept. It cannot be determined by an analysis of mechanical conditions alone. It is a ratio or relation between mechanical conditions and the ability of the tissue to sustain them. It may be called a mechanical tolerance; somewhat comparable to the sugar tolerance of an individual. In the consideration of traumatic occlusion, too often the mechanical conditions alone have been considered. To predict, therefore, what will happen to a denture simply by an analysis of the mechanical conditions is not wise. Resorption of the roots of teeth has undoubtedly been produced by orthodontic movement, but no satisfactory correlation has ever been established between resorption and methods of treatment. From the observation of cases in which root resorption has occurred in orthodontic treatment, it would seem justifiable to say that the resorption is usually not progressive after the completion of treatment and usually does not affect the functional efficiency of the denture. The work of Dr. Hermann Becks of the University of California has apparently established the relation between hypoparathyroidism and root resorption. He has shown that root resorption occurs in many hypoparathyroid patients who have had no orthodontic treatment or other mechanical stimulus. To predict the loss of the patient's teeth in the near future on the basis of root resorption or traumatic occlusion does not seem justified.—Queries and Minor Notes, *J.A.M.A.*, 110:148, January 8, 1938.

M. K. Hine.

Salivary Calculus Containing a Foreign Body

By J. Pitcher

A man, aged 28, complained chiefly of sore throat and inability to swallow solid foods. Twelve years previously, when he was chewing a piece of grass, the soft tissue under the left side of his tongue was punctured. He had

sought relief from several physicians, all of whom discredited his story. At one time, the area had abscessed and ruptured. A roentgenogram of the left submaxillary area showed a shadow in the soft tissue suggestive of a stone in the gland. Surgical removal of the mass yielded a stone measuring 3 by 5 mm. surrounding a piece of grass 6 mm. long. —*Arch. Otolaryn.*, 26:531, November 1937.

VIRGIL D. CHEYNE.

Salivary and Serumal Calculi

To the Editor: What is the cause for a secretion of salivary and serumal calculi on the lingual surfaces of the lower anterior teeth? Constant scaling removes the deposits for a short time, thus requiring almost weekly visits to the dentist. The calcium and phosphorous content of the blood is normal. There is no evidence of endocrine disturbance. There is prognathism of the lower jaw.

Answer: Salivary and serumal calculi are composed principally of a calcoglobulin which is deposited on the surfaces of the teeth. With the disintegration of protein, a hard residue of mineral is left. Salivary calculus occurs on the surfaces of the teeth above the gum line. It is most frequently found in proximity to the orifices of the salivary glands, namely, the lingual surfaces of the lower incisor teeth and the buccal surfaces of the upper molar teeth. Dr. G. V. Black, after experiments in his own and the mouths of others, was able to produce deposits of salivary calculus apparently related directly to the diet. In well-nourished persons, an excessive amount of protein and mineral frequently leaves deposits of this sort. Large quantities of milk and rich foods seem to predispose to the condition. Dr. Black was able to produce a deposit by the drinking of one glass of milk over and above a daily dietary intake that was not productive of calculus formation. If the diet is well balanced, merely a reduction in total quantity is often sufficient to reduce the deposits. Serumal calculus forms beneath the gingival margin. It is often associated with pockets that form with peridental disease. There is still considerable controversy concerning whether this deposit is the cause of the condition or merely coexistent with it. The chemical composition is similar to that of salivary calculus if not identical with it, its dark color being due to inclusion of blood pigment. It is probable that serumal calculus occurs because of the opportunity offered by the pyorrhea pocket and in turn contributes through irritation to the progress of this condition. In most instances, the quantity of deposits of both types of calculus can be controlled by careful regulation of the diet. The teeth should be kept scaled and as free from irritation of the soft tissue as possible in the meantime.—Queries and Minor Notes, *J.A.M.A.*, 110:227, January 15, 1938.

M. K. HINE.

A Case of Arsenical Poisoning: A Possible Idiosyncrasy

By G. CURNACK

AN exposed pulp was treated with an arsenious oxide (estimated at one-sixtieth grain) sealed in with gutta-percha, and left for forty-eight hours. At the second visit, the patient complained of much pain in the mouth. There was a slough of gum in the interdental space. Within a few hours after the application, the patient was violently ill with abdominal pains, vomiting and diarrhea. These symptoms were probably not due to poisoning because the official medicinal dose is one-sixteenth grain. This was probably an idiosyncrasy and a second application might have proved fatal. It is very necessary that this type of patient be warned of his condition so that he may enlighten other dentists or physicians who may treat him in the future.—*D. J. Australia*, 10:43, January 1938.

L. H. GARRISON.

Four Hundred and Four Consecutive Cases of Maxillary Sinusitis

By L. M. GRIFFITH

THE author presents a summary of the cases with figures to justify his conservative treatment. In that the results were good, he believes that conservative surgery in maxillary sinus disease is worth while if the case does not involve polyps or is of purely infectious origin. Of the 404 cases, 368 were acute, sixteen involved a Caldwell-Luc operation, and eight became chronic when radical surgery was refused and twelve when window openings were made beneath the inferior turbinate. The total number of antrum irrigations on these cases was 1,568. The patients who had repeated attacks of sinusitis were found to be allergic. In the series, bad teeth were not so frequently the causative agents at the onset of the antral infection as has been gen-

erally taught. Only 7.18 per cent of the cases were so caused. An ear inflammation was present in 4.7 per cent of the cases.—*South. Med. & Surg.*, 90:577, December 1937.

VIRGIL D. CHEYNE.

Experimental Production of Severe Homogeneous Osteoporosis by Gastrectomy in Puppies

By R. A. BUSSABARGER, S. FREEMAN and A. C. IVY.

To study the rôle of the gastric secretions in calcium absorption in the intestines, litter mates 105-172 days old were gastrectomized. Two puppies were kept as controls. At the end of the experimental period, the dogs were killed and a comparison of the bones and teeth of gastrectomized and normal dogs made. There was also evidence of enamel hypoplasia. The authors believe that the lack of gastric acidity results in failure to increase the solubility of the calcium salts and this, with the loss of the reservoir function of the stomach, is responsible for faulty calcium metabolism.—*Am. J. Physiol.*, 121:137, January 1938.

J. VOLKER.

An Improved Procaine Solution for Anesthesia

By A. WILLIAMSON, R. DALBY and C. ELLISON

AFTER a brief instructive discussion of the effect of pH and osmotic pressure on the action of local anesthetic solutions, the authors give the formula for a two-solution local anesthetic:

Solution A

Normal hydrochloric acid (36.5 gm. per liter), 1 cc.

Procaine hydrochloride, 48 gm.

Sterile distilled water, 1 liter

Solution B

Disodium phosphate crystals ($Na_2HPO_4 \cdot 12H_2O$), 30.3 gm.

Potassium dihydrogen phosphate (KH_2PO_4), 0.6 gm.

Sodium chloride, 8.0 gm.

Sterile distilled water, 1 liter

"Sterilize before using by boiling desired amounts of solutions A and B separately for fifteen minutes. Add 1 cc. of 0.1 per cent adrenalin chloride to and for every 25 cc. of solution A during the last minute of boiling. Do not add the adrenalin to solution B. Pour equal parts of A and B into a glass syringe in sufficient quantity to make 2 cc. Use within twenty-four hours after mixing."

This mixture gives an anesthetic of pH 7.5 and is isotonic with 0.91 per cent sodium chloride solution. It contains 2.4 per cent procaine hydrochloride and one part in 50,000 of adrenalin chloride. The separate solutions are stable.

The injection is painless and anesthesia is rapid and complete, with an operating period of one hour. Sensation returns in two hours with no "after-effect." These clinical results have been obtained in 2,000 cases.—*Brit. D. J.*, 64:85, 1938.

MARTIN DEAKINS.

Protective Shields in Radiation Therapy of Intra-Oral Cancer

By A. J. ACKERMAN

IN the construction of shields in radiation therapy, a knowledge of dental appliances, materials and anatomic structures is necessary. Satisfactory treatment is gained by the use of vulcanite rubber within which a lead protection sheet is vulcanized. The author further describes in detail the placement of the appliances for the control of malignancies of the oral cavity. By the use of principles mentioned in the article, the destructive results in the neighboring areas of normal tissues are avoided.—*Am. J. Roentgenol.*, 38:746, November 1937.

B. J. FREY.

Endemic Fluorosis in Madras Presidency

By H. SHORT, G. MCROBERT, T. BARNARD and A. MANNADI NAYAR

IN a study made of the effects of the rural water supply on the teeth of ten children admitted to the Presidency General Hospital, Madras, the authors observed mottled enamel characteristics in deciduous and permanent teeth, along with pyorrhea alveolaris. Hutchinsonian teeth were a common occurrence in these cases, but whether due "to fluorine intoxication or to syphilis" is uncertain. Further examination showed that besides the dental condition, there was a definite cachexia, spinal disability and disturbances in the skeletal, the respiratory and the urogenital systems. Roentgenograms indicated an excessive calcification of tendons, ligaments and fascia and an osteophytic formation of bone. The authors state that the biochemical estimation

of serum calcium, inorganic phosphate and serum phosphatase indicates a favorable condition for abnormal deposition of bone.—*Indian J. M. Res.*, 25:553, October 1937.

B. J. Frey.

Some Clinical Caprices of Hodgkin's Disease

By W. Middleton

This article describes an exhaustive study made of the constitutional symptoms expressed by Hodgkin's disease that sometimes prove fatal. The diagnosis was ultimately derived by exclusion or, as in the case cited, by an opportune biopsy. Focal infection was suspected in a woman 29 years of age, who had had a cough for one and one-half years and a listless feeling and had lost weight. The teeth were all extracted, with some improvement; but the cervical lymph nodes continued to enlarge. Five months later, there was an increase in weakness, with progressive enlargement of the cervical lymph nodes and a dry cough. Roentgenograms of the chest disclosed a superior mediastinal gland infection and biopsy confirmed the evidence of Hodgkin's disease.—*Ann. Int. Med.*, 11:448, September 1937.

B. J. Frey.

Subacute Magnesium Deficiency in Rats

By E. Watchom and R. McCance

On a diet containing approximately 40 parts per million of magnesium, rats developed diarrhea and melena, beginning about the tenth day. Hyperemia of the skin, loss of hair and sometimes hyperpnea and nervousness followed, but disappeared in from seven to ten days. The normal appearance persisted for about twelve weeks, followed by loss of appetite and poor physical condition. The kidneys were calcified, the bones brittle and the teeth sometimes white or translucent. Irregular striated dentin was found, no longer staining with hematoxylin, but exhibiting rings taking eosin and hematoxylin alternately. The odontoblasts tended to degenerate and disappear. The capillaries were enlarged. The molars contained pulp stones. The first changes were noted in two weeks. The bones contained more water and less magnesium than those of the controls. The magnesium content was about two-thirds normal. The calcium and phosphorus content was normal. The teeth contained more water and about 50 per cent of the magnesium content was normal. A small increase in phosphorus was found. Higher concentrations of magnesium seem to be necessary for normal tooth structure than for normal bone structure.—*Biochem. J.*, 31:1379, 1937.

Harold C. Hodge.

Ptyalin Content of Saliva in Old Age

By J. Meyer, J. Golden, N. Steiner and H. Necheles

Twenty-seven men and women ranging between 69 and 100 years, with an average age of 81 years, formed the experimental group, and twelve people with an average age of 25 acted as controls. The ptyalin content of saliva was tested by the method described by Hawk and Bergeim. The ptyalin content of the basal salivary secretion of the older group contained 0.303 unit of ptyalin per cubic centimeter of saliva; that of the younger, 10.15 units. When salivary secretion was stimulated, 0.28 and 8.20, respectively, were found. In old people, the burden of starch digestion is thrown on the pancreas.—*Am. J. Physiol.*, 119:600, 1937.

Virgil D. Cheyne.

Fusospirochetal Infection of the Lungs

By Francis M. Duffy

The author has considered this type of ailment from the standpoint of its bacteriology, predisposing causes, pathology, symptomatology, complications, diagnosis, treatment and prognosis. He describes no individual cases, but draws freely from his own experience in the discussion of the disease. In his consideration of predisposing causes, he regards germs from foci of infection in the mouth as the outstanding source of the infections. He states: "In all of the cases which I have studied and treated (over one hundred in number) I have been able to demonstrate these germs existing in association with various degrees of disease of the mouth." The author also observes that the infection implants itself in the bronchi and lungs only after some irritation of the endothelial lining of the pulmonary system; that is, the lung infections are preceded by "flu" or bad colds, pneumonia, asthma or general anesthesia. In one case, infection followed tonsillectomy.—*South. M. J.*, 30:1213, December 1937.

Grant Van Huysen.

BIBLIOGRAPHICAL

"The 1937 Year Book of Dentistry"

Edited by CHARLES G. DARLINGTON, M. D.; GEORGE W. WILSON, D.D.S.; HOWARD C. MILLER, D.D.S., CHARLES LANE, D.D. S., and GEORGE M. ANDERSON, D.D.S. Published by the Year Book Publishers, 304 South Dearborn Street, Chicago, Ill. Price $3.

This the second "Year Book of Dentistry" under the present editorship is surely to be as appreciatively received as was the first. The purpose of the year book as announced by the publisher is "to give the average practitioner a book that will enable him to make practical use of the year's important developments in dentistry." The scope and choice of the material presented and the manner of its presentation facilitate this objective quite admirably.

For the practitioner who desires to review the literary product of the year in condensed, readable form, the editors have made an exceedingly intelligent digest, presenting it in a form which should meet the demands of the dental practitioner who has for several years expressed a desire for condensed digested dental literature. The articles in the "Year Book" are not abstracted in short abbreviated form, but are digested in a manner that gives to the reader a comprehensive condensed digest, if these terms are not contradictory, readily enabling him to compass the trend as well as the actual development of dental practice.

The popularity of the first "Year Book," attested by the necessity for publication of three editions to supply the demand, more than warrants the continuance of the effort and should afford the publishers much satisfaction in the general approval of this manner of presenting dental literature in tabloid form.

Not only have the editors exhibited rare judgment in the choice of the material presented, but they have also, in many instances, greatly facilitated an understanding of the material reviewed and digested by intelligent interpretation of it.

We predict for the "Year Book" a permanent place in dental literature and one that will serve a helpful and useful purpose to the practitioner whose time for reading is limited.

The "Year Book for 1937" is somewhat enlarged, with more generous use of illustrations, over the first edition. The price, however, remains the same, $3, which is exceedingly reasonable for a well-prepared book containing 816 pages and 574 illustrations.

"Investigations into the Nature and Characteristic Features of Post-Normal Occlusion." Special Report Series, No. 225.

By MATTHEW YOUNG, ELSA JOHNSON, CORISANDE SMYTH and MILDRED STILL. Issued by the Medical Research Council. H. M. Stationery Office, Publisher, London: 1937. Price ls. 6d. net.

This report contains the results of two investigations into the nature and characteristic features of postnormal occlusion, a preliminary one dealing with boys at ages 8 to 9 years and another more extensive in scope dealing with both boys and girls from 8 to 13 years from the London County Council elementary schools.

The object of the investigations was to determine in what respects and to what extent children with well-defined postnormal occlusion differed in facial and dental arch dimensions and relationships from children with normal occlusion at different stages of growth, in the hope that a study of such deviations from the normal as might be found would throw some light on the origin of this common form of malocclusion.

The main result of the investigation is to provide very suggestive if not conclusive evidence that the origin of inferior postnormal occlusion in the great majority of the boys, but a smaller proportion of the girls, examined, is essentially dependent on the degree of forward growth or the position of the upper jaw and not on retrusion of the mandible. When protrusion of the upper jaw and retrusion of the lower coexist, the proportion in which protrusion is the more prominent feature is, in both sexes, equal

to that in which retrusion predominates. Children with the two principal types of postnormal occlusion do not appear to show significant differences in any of the characters brought under review except the two, transmeatal axis to upper incisor incisal margin and the length of the upper arch, in which the difference largely depends on the mode of differentiation of the two types, and possibly the height of the chin region.

MISCELLANY

NEWS

Deaths

Bodge, Frederick A., Somerville, Mass.; Tufts College Dental School, 1904; died November 28.

Christman, George, Jr., Cambridge, Mass.; Tufts College Dental School, 1912; died November 29.

Collins, O. W., Tipton, Ind.; Indiana University School of Dentistry, 1903; died December 16; aged 58.

Conlon, Thomas J., Boston, Mass.; School of Dentistry, University of Pennsylvania, 1899; died December 14.

Drewery, J. M., Nacogdoches, Texas; College of Dentistry, Baylor University, 1916; died January 23.

Fernandez, Edward M. S., Evanston, Ill.; Chicago College of Dental Surgery, 1892; died January 23; aged 86. Dr. Fernandez came to the United States from Costa Rica in 1867, and practiced dentistry for sixty-one years.

Frankel, Herman L., Chicago, Ill.; Northwestern University Dental School, 1898; died January 3; aged 65.

Harris, Charles F., Lowell, Mass.; Tufts College Dental School, 1886; died October 20.

Hassett, John E., Great Barrington, Mass.; Harvard University Dental School, 1906; died December 15.

Hinch, Leslie D., Chicago, Ill.; University of Illinois, College of Dentistry, 1914; died November 25; aged 46. Dr. Hinch was supervising dentist for the Chicago Board of Health.

Hollingsworth, Paul R., St. Louis, Mo.; St. Louis University School of Dentistry, 1921; died November 15.

Hopkins, Kenneth E., Connersville, Ind.; Indiana University School of Dentistry, 1924; died November 22; aged 36.

Hull, Roscoe H., Worcester, Mass.; Tufts College Dental School, 1895; died September 20.

Joerin, Charles, Jr., Detroit, Mich.; licensed by registration; died October 14.

Knapp, Emil, Evansville, Ind., died June 2; aged 83.

Kovalsky, Louis, Fall River, Mass.; Harvard University Dental School, 1913; died December 12.

Kunz, Wallace G., Kansas City, Kans.; Kansas City-Western Dental College, 1925; died November 15; aged 37.

Lamkin, Charles A., Hillsboro, Ore.; North Pacific College of Oregon, 1918; died October 17; aged 55.

Sellery, Ira Benson, Evanston, Ill.; Northwestern University Dental School, 1899; died January 22; aged 65. Dr. Sellery was a member of the faculty at Northwestern University Dental School from 1899-1930.

Smiley, R. M., Washington, Ind.; Indiana University School of Dentistry, 1886; died December 30; aged 78.

Smith, Frank J., Downers Grove, Ill.; University of Illinois College of Dentistry, 1910; died January 17; aged 60.

ANNOUNCEMENTS

ANNOUNCEMENTS must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

CALENDAR OF MEETINGS

American Dental Association, St. Louis, Mo., October 24-28.

American Academy of Restorative Dentistry, St. Louis, Mo., October 22-23.

American Society for the Advancement of General Anesthesia in Dentistry, New York City, fourth Monday in March and October.

American Society of Orthodontists, Los Angeles, Calif., July 11-14.

Five-State Postgraduate Clinic, Washington, D. C., March 6-9.

Great Lakes Association of Orthodontists, Cleveland, Ohio, November 7-8.

Southwestern Society of Orthodontists, Dallas, Texas, March 6-9.

Thomas P. Hinman Midwinter Clinic, Atlanta, Ga., March 14-15.

District of Columbia Dental Society, second and fourth Tuesdays in each month from October to June at the United States Public Health Service Auditorium, Washington.

Cleveland Dental Society, Cleveland, Ohio, April 4-5.

American Dental Society of Europe, Stockholm, August 1-3.

Baltimore College of Dental Surgery Alumni, Baltimore, Md., June 1-4.

New York College of Dentistry Class of 1923, New York City, April 7.

St. Louis University Dental Alumni Association, St. Louis, Mo., March 23-24.

Temple University Dental School Alumni, Philadelphia, Pa., May 25-27.

Montreal Dental Club Clinic, at Montreal, Canada, October 12-14.

Association of French-Speaking Dentists of North America, Montreal, Canada, June 2-5.

ARPA Internationale, Prague, Czechoslovakia, August 26-28.

American Dental Hygienists' Association, St. Louis, Mo., October 24-28.

American Dental Assistants Association, St. Louis, Mo., October 24-28.

STATE SOCIETIES

April

Alabama, at Birmingham (11-13)
Arizona, at Tucson (23-24)
California, at Stockton (4-6)
Kansas, at Wichita (24-27)
Kentucky, at Louisville (4-6)
Louisiana, at Alexandria (28-30)
Massachusetts, at Boston (25-28)
Michigan, at Detroit (18-20)
Mississippi, at Meridian (25-27)
New Jersey, at Atlantic City (20-22)
Oklahoma, at Tulsa (17-20)
Texas, at San Antonio (25-28)
Virginia, at Richmond (4-6)
Wisconsin, at Milwaukee (25-28)

May

Arkansas, at Little Rock (16-18)
Connecticut, at New Haven (4-6)
Georgia, at Macon (16-18)
Illinois, at Peoria (10-12)
Indiana, at Indianapolis (16-18)
Iowa, at Davenport (3-5)
Maryland, at Baltimore (2-3)
Missouri, at Columbia (8-9)
Montana, at Helena (5-7)
Nebraska, at Lincoln (16)
New York, at Syracuse (10-13)
North Carolina, at Winston-Salem (2-4)
North Dakota, at Minot (16-18)
Pennsylvania, at Philadelphia (3-5)
South Dakota, at Watertown (23-24)
Tennessee, at Chattanooga (9-12)
Vermont, at Rutland (18-19)
West Virginia, at Wheeling (16-18)

June

Colorado, at Estes Park (20-22)
Maine, at Portland (27-28)
Nevada, at Reno (4)
New Hampshire, at North Conway (6-7)
New Mexico, at Carlsbad

November

Ohio, at Cleveland
Florida, at Jacksonville (10-12)

STATE BOARDS OF DENTAL EXAMINERS

California, at San Francisco, May 23; at Los Angeles, June 20. Kenneth I. Nesbitt, 450 McAllister St., San Francisco, Secretary.

Florida, at Jacksonville, June 20. H. B. Pattishall, 351 St. James Bldg., Jacksonville, Secretary.

Iowa, at Iowa City, May 30-June 3. Hardy F. Pool, Mason City, Secretary.

Kentucky, June 14-17. Robert L. Sprau, 970 Baxter Ave., Louisville, Secretary.

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New Jersey, June 27-July 2. Walter A. Wilson, 148 W. State St., Trenton, Secretary.

North Carolina, at Raleigh, June 27. Wilbert Jackson, Rich Bldg., Clinton, Secretary.

North Dakota, at Fargo, July 11-14. W. E. Cole, Bismarck, Secretary.

Ohio, at Columbus, June 27. Morton H. Jones, 1553½ North Fourth St., Columbus, Secretary.

Tennessee, at Memphis, June 13. B. C. Gallimore, Commercial Bank Bldg., McKenzie, Secretary.

Wisconsin, at Milwaukee, June 20-24. S. F. Donovan, Tomah, Secretary.

FLORIDA STATE BOARD OF DENTAL EXAMINERS

The annual examination for license to practice dentistry and to practice dental hygiene will be held in Jacksonville, commencing June 20 at the Seminole Hotel. Preliminary applications must be filed sixty days prior to date of examination. Address all communications to

H. P. Pattishall, *Secretary,*
351 St. James Bldg.,
Jacksonville.

BOARD OF DENTAL EXAMINERS OF THE STATE OF MAINE

The next examination to be conducted by the Maine Board of Dental Examiners will be held in Augusta, June 23-25, for dentists and hygienists. All applications must be on file ten days before the examinations. For applications and information, address

Fred B. Wheaton, *Secretary,*
319 Main St.,
Biddeford.

MONTANA STATE BOARD OF DENTAL EXAMINERS

The next examinations by the Board of Dental Examiners of Montana for license to practice dentistry and dental hygiene will be held at Helena commencing July 11. Applications must be in the office of the secretary at least twenty days prior to the date of the examinations.

Leonard A. Jenkin, *Secretary,*
401 Ford Bldg.,
Great Falls.

NORTH CAROLINA STATE BOARD OF DENTAL EXAMINERS

The next regular meeting of the North Carolina State Board of Dental Examiners will be held at the State Capitol, Raleigh, beginning June 27. Applications must be filed with the secretary thirty days before the examination. For application blanks and further information, address

Wilbert Jackson, *Secretary,*
Rich Bldg.,
Clinton.

OHIO STATE DENTAL BOARD

The June examination of the Ohio State Dental Board will be held at the College of Dentistry, Ohio State University, Columbus, the week beginning Monday, June 27. All applications must be in the hands of the secretary at least ten days before the date of the examination. For further information, address

Morton H. Jones, *Secretary,*
1553½ North Fourth St.,
Columbus.

WISCONSIN STATE BOARD OF DENTAL EXAMINERS

The next examination of the Wisconsin Board of Dental Examiners will be held at Marquette Dental School, Milwaukee, June 20-24. Address all communications to

S. F. Donovan, *Secretary,*
Tomah.

GREAT LAKES ASSOCIATION OF ORTHODONTISTS

The twelfth annual meeting of the Great Lakes Association of Orthodontists will be held in Cleveland, November 7-8, at the Hotel Statler.

Richard E. Barnes, *Secretary,*
1704 Republic Bldg.,
Cleveland.

TEMPLE UNIVERSITY DENTAL SCHOOL ANNIVERSARY

The Temple University Dental School (Philadelphia Dental College) will celebrate the seventy-fifth anniversary of its founding May 25-27. All alumni are urged to participate in celebrating this diamond jubilee.

JAMES W. CRAIG, *Publicity Chairman,*
812 Garrett Road,
Upper Darby, Pa.

EXAMINATION FOR DENTAL INTERNSHIP, BRONX HOSPITAL

The Bronx Hospital, New York City, will hold an examination for dental internship (for one year beginning August 1) Thursday, April 14, at 7:30 p. m. in the hospital. The Bronx Hospital is a modern hospital with a capacity of 310 beds for acute diseases. It has a very active outpatient department in all branches of dentistry, including periodontia, oral surgery, root canal therapy and operative dentistry. Write for application form to

WILLIAM B. SELTZER, *Superintendent,*
Fulton Ave. at 169th St.,
Bronx, N. Y.

AMERICAN DENTAL HYGIENISTS' ASSOCIATION

The American Dental Hygienists' Association will meet in St. Louis, Mo., October 24-28.

DAISY M. BELL, *Secretary,*
974 Amherst St.,
Buffalo, N. Y.

AMERICAN DENTAL ASSISTANTS ASSOCIATION

The fourteenth annual session of the American Dental Assistants Association will be held at St. Louis, Mo., October 24-28. For further information, address

LUCILE S. HODGE, *General Secretary,*
401 Medical Arts Bldg.,
Knoxville, Tenn.

UNITED STATES PATENTS APPLICABLE OR PERTAINING TO DENTISTRY ISSUED DURING DECEMBER 1937 AND JANUARY 1938

December 7

No. 2,101,363, to LESTER L. DEROME. Sanitary Tooth Cleanser.

No. 2,101,431, to FRAZIER GROFF. Denture Blank.

No. 2,101,776, to ARNOLD H. FELDMAN. Mold Flask Separator.

December 14

No. 2,102,023, to AUSTIN A. OVERBURY. Surgical Lamp.

No. 2,102,263, to HUBERT GRUNEWALD. Saliva Ejector.

December 21

No. 2,102,591, to HEINRICH HAGEMEIR. Dental Syringe.

No. 2,102,643, to DOMENICK PELLEGRINI. Denture Cleaning Device.

No. 2,102,704, to GEORGE N. HEIN. Syringe Cartridge.

No. 2,103,058, to GEORGE HENRY BURTENSHAW. Denture Demonstrating Device.

No. 2,103,115, to DAN D. MIZZY and DAVID L. DURST. Dental Jack.

No. 2,103,144, to JEAN CARRE. Apparatus for Giving Anesthetics.

January 4

No. 2,104,192, to JAMES W. FORD. Orthodontic Appliance.

No. 2,104,198, to CLEVOE JONES. Magnifying and Illuminating Device.

No. 2,104,459, to ALFRED GYSI. Artificial Teeth.

No. 2,104,470, ORVILLE A. ROLAND. Denture Kit.

No. 2,104,670, to ALPHONSE F. PIEPER. Dental Syringe.

No. 2,104,715, to JACOB A. SAFFIR. Dental X-Ray Film Package.

Des. 107,820, to LEON M. FARNUM and CLARENCE K. TEAMER. Design for a Blowpipe.

January 11

No. 2,104,753, to RANDOLPH T. MAJOR and ALBERT B. BOESE. Local Anesthetic.

No. 2,104,988, to J. A. HEIDBRINK. Anesthetizing Machine.

No. 2,105,398, to ADOLPH BARRETT and LEO HIRSCHHORN. Reinforced Porcelain Tooth Crown.

January 18

No. 2,105,623, to WALTER J. VAN ROSSEM. Flexible Package for Hydrocolloid Impression Materials.

No. 2,106,125, to LESLIE NORMAN BOEBUCK and SAMUEL JAMES EVERETT. Mechanism for Grinding Artificial Dentures.

January 25

No. 2,106,252, to VINCENT J. LUONGO. Dental Tool.

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